11. APPENDICES

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10. NOTES

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9. GLOSSARY

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RISC	-	Reduced Instruction Set Computer
ROM	-	Read Only Memory
RTF	-	Rich Text Format
RTM	-	Requirements Traceability Management
SA	-	System Architect
SCM	-	Software Configuration Management
SCSI	-	Small Computer System Interface
SDP	-	Software Development Plan
SGML	-	Standard Graphics Markup Language
SMAP	-	Software Management and Assurance Program
SOW	-	Statement Of Work
SSEC	-	Space Science and Engineering Center
SSIM	-	Spacecraft Simulation
STD	-	Standard
TAR	-	Technical Analysis Report
TBD	-	To Be Determined
TCP/IP	-	Transmission Control Protocol/ Internet Protocol
TMDB	-	Test Management Data Base
TRMM	-	Tropical Rainfall Measuring Mission
UAF	-	University of Alaska
UTP	-	Unshielded Twisted Pair
V&V	-	Verification and Validation
VBX	-	Visual Basic Extension
WAN	-	Wide Area Network
WBS	-	Work Breakdown Structure
WVU	-	West Virginia University
WWW	-	World Wide Web

ICD	-	Interface Control Documents
IIR	-	Integrated Information Repository
ISE	-	Integrated Support Environment
IRVVP	-	Independent Release Verification and Validation Plan
ISVVP	-	Independent System Verification and Validation Plan
IV&V	-	Independent Verification and Validation
IVVMP	-	Independent Verification and Validation Management Plan
IRD	-	Interface Requirement Document
IRIS	-	Incorporated Research Institutions for Seismology
ISVVP	-	Independent System Verification and Validation Plan
ISE	-	Integrated Support Environment
JPL	-	Jet Propulsion Lab
Kbps	-	Kilobits per second
LAN	-	Local Area Network
LaRC	-	Langley Research Center
MB	-	MegaByte
Mbps	-	Megabits per second
MHZ	-	MegaHertz
MIS	-	Management Information System
MITI	-	Ministry of International Trade and Industry
MOU	-	Memorandum Of Understanding
mm	-	millimeter
MSFC	-	Marshall Space Flight Center
NASDA	-	National Space Development Agency (Japan)
NASA	-	National Aeronautics And Space Administration
NVRAM	-	Non Volatile Random Access Memory
NMC	-	National Meteorological Center
NOAA	-	National Oceanographic and Atmospheric Administration
NMC	-	National Meteorological Center
NSF	-	National Science Foundation
NSIDC	-	National Snow and Ice Data Center
OLE	-	Object Linking and Embedding
PAR	-	Performance Assurance Requirements
PC	-	Personal Computer
PCMCIA	-	Personal Computer Memory Card Interface Association
PDF	-	Portable Data Format
PERT	-	Program Evaluation Review Technique
PFR	-	Problem Failure Reports
ppm	-	pages per minute
Proc	-	Procedure
PSCN	-	Program Support Communication Network
PVCS	-	Polytron Version Control System
RAM	-	Random Access Memory
RDBMS	-	Relational Data Base Management System
RID	-	Review Item Discrepancy

8. ABBREVIATIONS AND ACRONYMS

Below are a list of the abbreviations and acronyms used in this document.

API	-	Application Programming Interface
ARDB	-	Automated Requirements Database
BONeS	-	Block Oriented Network Simulator
CARA	-	Criticality Analysis and Risk Analysis
CASE	-	Computer Aided Software Engineering
CD	-	Compact Disk
Cert	-	Certification
CM	-	Configuration Management
COTR	-	Contracting Officers Technical Representative
COTS	-	Commercial Off-The-Shelf
DAAC	-	Distributed Active Archive Center
DDE	-	Dynamic Data Exchange
DDTs	-	Distributed Defect Tracking system
DID	-	Data Item Description
DM	-	Data Management
Doc	-	Document
DOS	-	Disk Operating System
dpi	-	dots per inch
DR	-	Discrepancy Report
Ecom	-	EOS Communication System
ECS	-	EOSDIS Core System
EDHS	-	Electronic Data Handling System
EDOS	-	EOS Data and Operations System
EICP	-	EOSDIS Integration and Certification Plan
EOS	-	Earth Observing System
EOSDIS	-	Earth Observing System Data Information System
ESA	-	European Space Agency
ESDIS	-	Earth Science Data Information System
FTP	-	File Transfer Protocol
GB	-	GigaByte
GFE	-	Government Furnished Equipment
GOTS	-	Government Off The Shelf
GS	-	Ground System
GSFC	-	Goddard Space Flight Center
GUI	-	Graphic User Interface
HAIS	-	Hughes Automated Information Systems
HD	-	Hard Drive
HDS	-	Human Designed Systems
HTML	-	HyperText Markup Language
HTTP	-	HyperText Transfer Protocol
IADB	-	Interface Analysis Data Base

7. PARTITIONING FOR INCREMENTAL DEVELOPMENT

The incremental releases associated with the ISE are still to be determined. They will be identified in the Software Development Plan (SDP) that is to be finalized in February of 1995.

ISE System Requirements	Tool Element Paragraph	ISE Tool Element
ISE-T9-0210	5.2.2.1.1.9	Microsoft Project
4.3.9 Development of EOS Ground System Cert Plan - Task 10		
ISE-T10-0010	5.2.2.1.1.3	DDTs
ISE-T10-0020	5.2.2.1.1.4	ClearCase
ISE-T10-0030	5.2.2.1.1.5 5.2.2.1.1.6 5.2.2.1.1.7	XRunner LoadRunner Xoftware
4.3.10 Key Interface Testing - Task 11		
ISE-T11-0010	5.2.2.1.1.8 5.2.2.1.4.2.4 5.2.2.1.4.2.2	Microsoft Office Pro CARA Data Capture Interface Analysis Database
ISE-T11-0020	5.2.2.1.1.8 5.2.2.1.4.1.1	Microsoft Office Pro Document Production Tool
ISE-T11-0030	5.2.2.1.4.2.3	Test Management Database
ISE-T11-0040	5.2.2.1.4.2.3 5.2.2.1.1.4	Test Management Database ClearCase
ISE-T11-0050	5.2.2.1.4.2.3 5.2.2.1.1.4	Test Management Database ClearCase
ISE-T11-0060	5.2.2.1.4.2.3	Test Management Database
ISE-T11-0070	5.2.2.1.1.9 5.2.2.1.4.2.3	Microsoft Project Test Management Database
ISE-T11-0080	5.2.2.1.4.2.3	Test Management Database
ISE-T11-0090	5.2.2.1.1.5 5.2.2.1.1.6 5.2.2.1.1.7	XRunner LoadRunner Xoftware
ISE-T11-0100	5.2.2.1.1.8 5.2.2.1.4.2.2 5.2.2.1.4.1.1	Microsoft Office Pro Interface Analysis Database Document Production Tool
ISE-T11-0110	5.2.2.1.1.3 5.2.2.1.1.10 5.2.2.1.4.2.3 5.2.2.1.4.1.1	DDTs cc:Mail Test Management Database Document Production Tool
ISE-T11-0120	5.2.2.1.1.6	LoadRunner

Exhibit 6-1 Requirements Traceability Matrix (continued)

ISE System Requirements	Tool Element Paragraph	ISE Tool Element
ISE-T5-0040	5.2.2.1.1.8 5.2.2.1.4.2.4	Microsoft Office Pro CARA Data Capture
ISE-T5-0050	5.2.2.1.4.2.1	Automated Requirements Database
ISE-T5-0060	5.2.2.1.4.2.1	Automated Requirements Database
ISE-T5-0070	5.2.2.1.4.2.1	Automated Requirements Database
ISE-T5-0080	5.2.2.1.4.2.1	Automated Requirements Database
4.3.8 Key Interface Analysis - Task 9		
ISE-T9-0010	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0020	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0030	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0040	5.2.2.1.1.1 5.2.2.1.4.2.2	RTM/Oracle Interface Analysis Database
ISE-T9-0050	5.2.2.1.4.2.2 5.2.2.1.4.1.1	Interface Analysis Database Document Production Tool
ISE-T9-0060	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0070	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0080	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0090	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0100	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0110	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0120	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0130	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0140	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0150	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0160	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0170	5.2.2.1.4.2.2	Interface Analysis Database
ISE-T9-0180	5.2.2.1.1.8 5.2.2.1.4.2.2 5.2.2.1.4.1.1	Microsoft Office Pro Interface Analysis Database Document Production Tool
ISE-T9-0190	5.2.2.1.4.2.2 5.2.2.1.1.10 5.2.2.1.1.3	Interface Analysis Database cc:Mail DDTs
ISE-T9-0200	5.2.2.1.4.2.2 5.2.2.1.1.3	Interface Analysis Database DDTs

Exhibit 6-1 Requirements Traceability Matrix (continued)

ISE System Requirements	Tool Element Paragraph	ISE Tool Element
ISE-T2-0030	5.2.2.1.4.1.2 5.2.2.1.1.8	Data Management Tool Microsoft Office Pro
4.3.5 Plans - Task 3		
ISE-T3-0010	5.2.2.1.1.8 5.2.2.1.1.11	Microsoft Office Pro Lotus Notes
ISE-T3-0020	5.2.2.1.1.8 5.2.2.1.1.11	MS Office Lotus Notes
4.3.6 Infrastructure and Tool Development - Task 4		
ISE-T4-0010	5.2.2.1.1.16	System Architect
ISE-T4-0020	5.2.2.1.1.8	Microsoft Office Pro
ISE-T4-0030	5.2.2.1.1.9	Microsoft Project
ISE-T4-0040	5.2.2.1.1.8 5.2.2.1.1.11	Microsoft Office Pro Lotus Notes
ISE-T4-0050	5.2.2.1.1.13	PVCS
ISE-T4-0060	5.2.2.1.1.8	Microsoft Office Pro
ISE-T4-0070	5.2.2.1.1.14	SQLWindows
ISE-T4-0080	5.2.2.1.1.8 5.2.2.1.1.11	Microsoft Office Pro Lotus Notes
ISE-T4-0090	5.2.2.1.1.8 5.2.2.1.1.11	Microsoft Office Pro Lotus Notes
ISE-T4-0100	5.2.2.1.1.8 5.2.2.1.1.11	Microsoft Office Pro Lotus Notes
ISE-T4-0110	5.2.2.1.1.8 5.2.2.1.1.11 5.2.2.1.1.14 5.2.2.1.1.17 5.2.2.1.2.1 5.2.2.1.2.2	Microsoft Office Pro Lotus Notes SQLWindows Visual C++ Mosaic Web Genera
4.3.7 Requirements Analysis and Traceability - Task 5		
ISE-T5-0010	5.2.2.1.1.1	RTM/Oracle
ISE-T5-0020	5.2.2.1.4.2.1	Automated Requirements Database
ISE-T5-0030	5.2.2.1.1.8 5.2.2.1.4.2.4	Microsoft Office Pro CARA Data Capture

Exhibit 6-1 Requirements Traceability Matrix (continued)

ISE System Requirements	Tool Element Paragraph	ISE Tool Element
ISE-TB-0040	5.2.2.1.2.1 5.2.2.1.4.3.2	Mosaic Browsers
ISE-TB-0050	5.2.2.1.1.2	BONeS
ISE-TB-0060	5.2.2.1.1.8 5.2.2.1.1.12	Microsoft Office Pro Adobe Acrobat
ISE-TB-0070	5.2.2.1.1.8	Microsoft Office Pro
ISE-TB-0080	5.2.2.1.1.8	Microsoft Office Pro
ISE-TB-0090	5.2.2.1.1.11	Lotus Notes
ISE-TB-0100	5.2.2.1.1.8 5.2.2.1.1.15	Microsoft Office Pro SYBASE SQL Server
ISE-TB-0110	5.2.2.1.1.9	Microsoft Project
ISE-TB-0120	5.2.2.1.1.4 5.2.2.1.1.13	ClearCase PVCS
ISE-TB-0130	5.2.1.2.1 5.2.1.2.2 5.2.2.1.1.10	Electronic Mail File Transfer cc:Mail
ISE-TB-0140	5.2.2.1.3	Operating System Software
ISE-TB-0150	5.2.2.1.1.7	Xoftware
4.3.3 Project Management - Task 1		
ISE-T1-0010	5.2.2.1.1.8 5.2.2.1.1.11	Microsoft Office Pro Lotus Notes
ISE-T1-0020	5.2.2.1.1.8	Microsoft Office Pro
ISE-T1-0030	5.2.2.1.1.8 5.2.2.1.4.2.4	Microsoft Office Pro CARA Data Capture
ISE-T1-0040	5.2.2.1.1.8 5.2.2.1.1.11	Microsoft Office Pro Lotus Notes
ISE-T1-0050	5.2.2.1.1.9	Microsoft Project
ISE-T1-0060	5.2.2.1.1.10 5.2.2.1.1.11	cc:Mail Lotus Notes
4.3.4 Facilities, Operations, and Program Reporting - Task 2		
ISE-T2-0010	5.2.2.1.1.8 5.2.2.1.1.11	Microsoft Office Pro Lotus Notes
ISE-T2-0020	5.2.2.1.1.8	Microsoft Office Pro

Exhibit 6-1 Requirements Traceability Matrix (continued)

ISE System Requirements	Tool Element Paragraph	ISE Tool Element
ISE-IIR-0060	5.2.2.1.1.8	Microsoft Office Pro
	5.2.2.1.2.3	Acrobat Reader
	5.2.2.1.2.1	Mosaic
	5.2.2.1.4.3.2	Browsers
	5.2.2.1.4.2.4	CARA Data Capture
ISE-IIR-0070	5.2.2.1.2.3	Acrobat Reader
	5.2.2.1.2.1	Mosaic
	5.2.2.1.4.3.2	Browsers
ISE-IIR-0080	5.2.2.1.2.3	Acrobat Reader
	5.2.2.1.2.1	Mosaic
	5.2.2.1.4.3.2	Browsers
	5.2.2.1.1.3	DDTs
ISE-IIR-0090	5.2.2.1.2.3	Acrobat Reader
	5.2.2.1.2.1	Mosaic
	5.2.2.1.4.3.2	Browsers
ISE-IIR-0100	5.2.2.1.2.3	Acrobat Reader
	5.2.2.1.2.1	Mosaic
	5.2.2.1.4.3.2	Browsers
ISE-IIR-0110	5.2.2.1.2.3	Acrobat Reader
	5.2.2.1.2.1	Mosaic
	5.2.2.1.4.3.2	Browsers
ISE-IIR-0120	5.2.2.1.2.3	Acrobat Reader
	5.2.2.1.2.1	Mosaic
	5.2.2.1.4.3.2	Browsers
ISE-IIR-0130	5.2.2.1.2.3	Acrobat Reader
	5.2.2.1.2.1	Mosaic
	5.2.2.1.4.3.2	Browsers
ISE-IIR-0140	5.2.2.1.2.3	Acrobat Reader
	5.2.2.1.2.1	Mosaic
	5.2.2.1.4.3.2	Browsers
	5.2.2.1.4.1.2	Data Management Tool
4.3.2 Toolbox Requirements		
ISE-TB-0010	5.2.2.1.1.3	DDTs
ISE-TB-0020	5.2.2.1.4.2.2	Interface Analysis Database
	5.2.2.1.1.2	BONeS
ISE-TB-0030	5.2.2.1.1.1	RTM/Oracle

Exhibit 6-1 Requirements Traceability Matrix (continued)

6. REQUIREMENTS ALLOCATION AND TRACEABILITY

Exhibit 6-1 below reflects the traceability of the ISE system level requirements to elements of the ISE System Architecture.

ISE System Requirements		Tool Element Paragraph	ISE Tool Element
4.2	**ISE Operational Requirements**		
	ISE-OPS-0010	5.2.2.1.2.1 5.2.2.1.4.3.1 5.2.2.1.4.3.2	Mosaic Executive Interface Browsers
	ISE-OPS 0020	5.2.1.1.1.2.1 5.2.1.1.1.2.2	PC Software Unix Software
	ISE-OPS-0030	5.2.1.1.1.2.1 5.2.1.1.1.2.2	PC Software Unix Software
	ISE-OPS 0040	5.2.1.1.1.2.1 5.2.1.1.1.2.2	PC Software Unix Software
	ISE-OPS-0050	5.2.2.1.2.1 5.2.2.1.4.3.1 5.2.2.1.4.3.2	Mosaic Executive Interface Browsers
	ISE-OPS 0060	5.2.1.2.2	File Transfer
4.3	**Functional Requirements**		
4.3.1	**IIR Requirements**		
	ISE-IIR-0010	5.2.2.1.2.3 5.2.2.1.2.1 5.2.2.1.4.3.2	Acrobat Reader Mosaic Browsers
	ISE-IIR-0020	5.2.2.1.2.3 5.2.2.1.2.1 5.2.2.1.4.3.2	Acrobat Reader Mosaic Browsers
	ISE-IIR-0030	5.2.2.1.2.3 5.2.2.1.2.1 5.2.2.1.4.3.2	Acrobat Reader Mosaic Browsers
	ISE-IIR-0040	5.2.2.1.2.3 5.2.2.1.2.1 5.2.2.1.4.3.2 5.2.2.1.4.2.1 5.2.2.1.1.1	Acrobat Reader Mosaic Browsers Automated Requirements Database RTM/Oracle
	ISE-IIR-0050	5.2.2.1.1.1 5.2.2.1.4.2.3	RTM/Oracle Test Management Database

Exhibit 6-1 Requirements Traceability Matrix

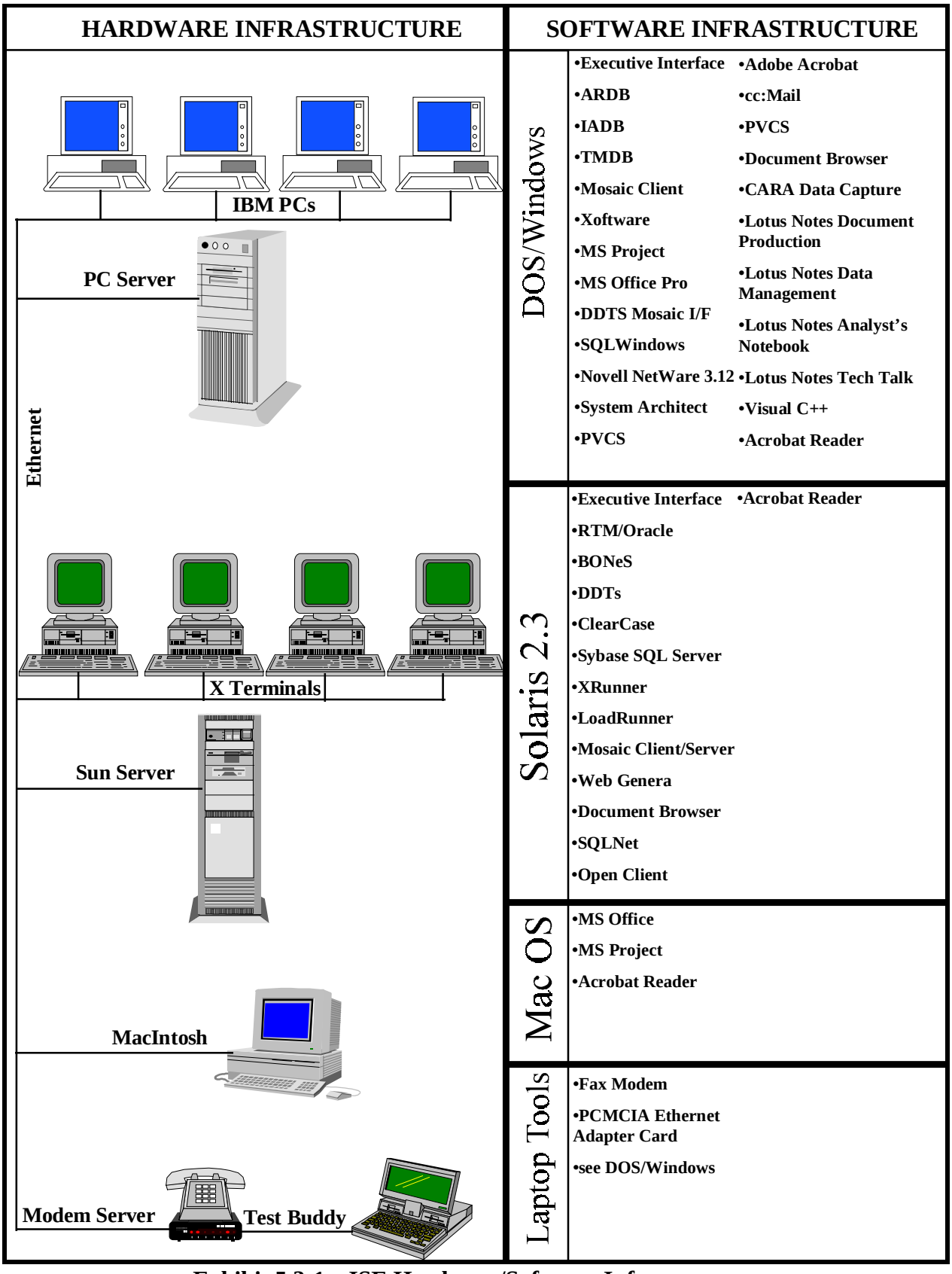

Exhibit 5.3-1 ISE Hardware/Software Infrastructure

Various Lotus Notes applications have been developed and the databases are resident to the PC file server. Lotus Notes databases are nonrelational databases, but do support text searching capabilities. For details associated with the Lotus Notes applications, refer to section 5.2.2.1.4.1 of this document.

5.2.3.1.2.2. Microsoft Access Databases

Microsoft Access is a RDBMS product that provides a forms front-end for building GUI applications to manipulate the RDBMS. It is a component of the Microsoft Office Pro product suite. Shared Access databases reside on the PC file server. Currently, the interface analysis database (IADB) prototype is a Microsoft Access database application. For details regarding the IADB, refer to section 5.2.2.1.4.2.2 of this document. Other Access database applications will be implemented on an as needed basis in support of various CARA activities.

5.2.4. Test Buddy

The Test Buddy corresponds to a powerful laptop or mobile PC with both modem and network capabilities. The Test Buddy includes the majority of the capabilities and COTS tools included on the PC platform. A tentative minimal configuration for the Test Buddy has been detailed to include:

- DX4-75 MHz CPU
- 540 MB Hard Disk
- 16MB of RAM
- 4 hour battery life
- PCMCIA slot
- 14.4 fax/voice/data modem
- Ethernet networking card
- Active Matrix Color Display
- parallel and serial ports

5.3. Comprehensive Integrated Architecture

In Section 5.1, the Functional Architecture addressed the various functional capabilities that must be supported by the ISE. In Section 5.2, the Physical Architecture detailed the network/computational infrastructure, the software infrastructure, and provided a high level data view of the ISE. The establishment of the ISE is essential to the EOSDIS IV&V effort so that IV&V activities are carried out in an effective and productive manner. The ISE System Architecture presented reflects a networked heterogeneous environment incorporating several COTS products and a few developed or customized applications. The ISE, as it is depicted in Exhibit 5.3-1, provides a sound foundation which is flexible and supportive for incrementally adding tools as new needs and requirements are levied against it.

5.2.3.1.1.4. Simulation Model Files

Simulation model data associated with the BONeS product is stored using a flat-file storage structure. These files are hosted on the Sun SPARC server in conjunction with the BONeS tool.

5.2.3.1.1.5. Software Configuration Files

Software configuration files associated with the ClearCase CM tool are hosted on the Sun SPARC file server. These files come from a wide variety of sources and in multiple formats. Examples include test scripts, test data, etc.

5.2.3.1.1.6. PDF Files

The Portable Document Format (PDF) is a document format used for creating easily transportable versions of documents whose native format may not be easily or readily transferable. Additionally, PDF files, created using the Adobe Acrobat application, can be viewed using a shareware viewing tool available via the Internet and that the EOSDIS project can freely distribute. PDF files are a means of disseminating and sharing reports and other documentation with the clients and other users of the EOSDIS IV&V data and information.

5.2.3.1.1.7. HTML Files

The HyperText Markup Language (HTML) is a formatting language based on SGML. HTML is the document format interpreted by Mosaic and other browsers on the World Wide Web. HTML supports simple formatting conventions (e.g. bold and italic typeface), as well as more complex constructs such as interactive forms and interactive graphic maps. The EOSDIS IV&V program is using HTML to generate 'Home Pages' that provide an information conduit to all levels of users.

5.2.3.1.2. PC File Server

The PC file server hosts several COTS products and data associated with them which is to be shared. The following subsections provide an overview of the database data to be hosted on the PC file server.

5.2.3.1.2.1. Lotus Notes Databases

in significant benefits due to the seamless information sharing that can be achieved between COTS products. Refer to section 5.2.2.1.4.2, RDBMS Client Server Applications for details associated with planned client/server development using the SQLWindows client/server development tool.

5.2.3.1.1. Sun File Server

The Sun SPARC file server hosts several COTS products and their corresponding data. Some of these COTS products are layered on an RDBMS where others utilize a flat-file storage structure. The following subsections provide an overview of tool related data to be hosted on the Sun SPARC file server.

5.2.3.1.1.1. Requirements Traceability Database

The database housing requirements traceability data is an Oracle RDBMS. The RTM COTS product utilizes 54 Oracle tables to store requirements traceability information. Read access is permitted to the Oracle database to query for specific information (e.g. requirement text for a given requirement identifier) using an established project account and password. This allows client/server applications to draw traceability information from the RTM/Oracle database for use. The network gateway to the RTM/Oracle database is provided by the SQLNet product from Oracle Corporation.

5.2.3.1.1.2. Discrepancy Tracking and Reporting Database

The discrepancy tracking and reporting database associated with the DDTs COTS product currently uses a flat-file storage structure. A future release of DDTs is planned which will include a SQL database as the data storage mechanism. Once the SQL database implementation is released, data sharing with other COTS tools via client/server applications will be enhanced. Currently, DDTs does allow for submission of discrepancies via Internet mail.

5.2.3.1.1.3. Client/Server Application Development Database

Various client/server applications are being targeted to provide a custom interface for specific activities, to automate labor intensive activities, and to achieve data integration of COTS product information where interrelationships exist. The storage of data associated with these applications will be stored in a RDBMS. Currently, the SYBASE SQL Server RDBMS is being evaluated and is considered to be the leading candidate. One potential reason for selecting SYBASE is that a freeware product, Web Genera, has been developed which allows access to SYBASE hosted data through a Mosaic GUI. This could prove to be highly beneficial for exporting data that is accessible for viewing by various ISE external users.

5.2.3. IIR

The data view of the ISE System Architecture is a reflection of the composition of the IIR. Exhibit 5.2.3-1 depicts the various COTS databases associated with tool selections as well as data hosted on both the PC and Sun SPARC server which comprise the IIR.

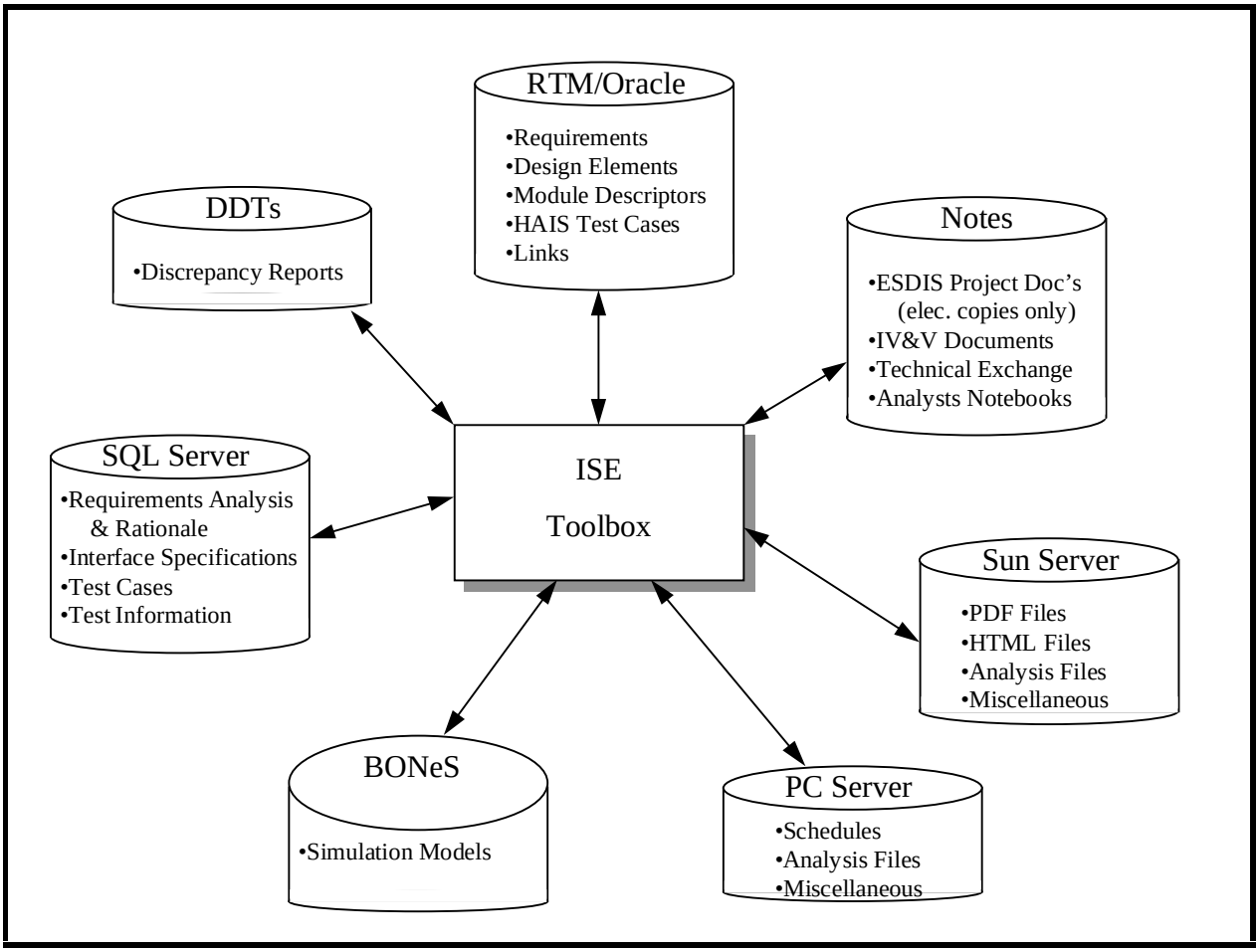

Exhibit 5.2.3-1 IIR Data Storage

5.2.3.1. COTS and Infrastructure Implications

As a direct result of the ISE design approach to incorporate COTS solutions for satisfying the IV&V task needs, the data included in the IIR is hosted in numerous RDBMS and flat file storage mechanisms. This results in a data view that is anything but integrated. However, data integration is achieved to an extent through adhering to a client/server development approach which allows for data extraction from various sources which is transparent to the end user. Thus, data integration is achieved by executing client/server applications to support IV&V activities where database interrelationships are hidden from the application user. This approach can result

Exhibit 5.2.4-1 ISE Function/Tool Mapping

Functions \ Tools	RTM	SQL Net	BONeS	DDTs	Clear Case	X Runner	Load Runer	Xoftware	MS Office	MS Project	Lotus Notes	cc Mail	Adobe Acrobat	PVCS	SQL Windows	Sybase	Open Client	System Architect	Visual C++	Mosaic	Web Genera	Acrobat Reader	ARDB	IADB	TMDB	TBD	OS
Requirements Evaluation															P_S	X_S							P				
Traceability Analysis	X							P_S															P				
Interface Analysis															P_S	X_S								P			
System Modeling and Simulation			X					P_S																			
Design Analysis			X					P_S																		X	
Code Analysis																										X	
Test Planning									PM	PM															P		
Test Execution						X	X	P_S																		X	
Test Analysis/ Mgmnt.	X														P_S	X_S									P		
Discrepancy Tracking and Reporting				X				P_S	P_S		P_S				P_S	X_S				PLX	PX_S					P	
Activity Scheduling	X									PM					P_S	X_S									P		
Document Navigation and Browsing													P_S							PLX		PLX					
Equipment Management											P																
Analyst's Notebook									PLM		PL																
CARA									P_S						P_S	X_S										P	
Executive Interface									P_S						P_S					PLX						PLX	
Office Automation									PLM		PL	PL															
Document Mgmnt.											PL		P														
Database Mgmnt.	X								PL		PL					X											
Configuration Mgmnt.					X			P						PX													
File Mgmnt.																											A
ISE Dev. & Admin.		X_S							P	P_S			P_S	PX$_S$	P	X	X_S	P_S	P	PX	PX_S	PX_S					A_S

Legend: **X** - Sun Solaris Platform , **P** - PC MS Windows Desktop, **L** - PC MS Windows Notebook, **M** - Macintosh, **A** - All Platforms
$_S$ - Support Application, ▢ -Under Evaluation

5.2.2.3. Functions versus Implementations

The ISE System Architecture is being communicated via functional and physical perspectives. The functional architecture was detailed in section 5.1 and probable solutions in support of these functions were detailed in section 5.2.1, Network/Computational Infrastructure, and section 5.2.2.1, Tool Descriptions. Exhibit 5.2.2.3-1 reflects a mapping of viable implementations to functions.

Tools \ Status	Freeware/ Shareware	COTS Procured	COTS Under Procurement	COTS Leading Candidate	To Be Developed	To Be Determined
COTS Software						
RTM/Oracle		X				
SQLNet			PLX			
BONeS		X				
DDTs				X		
ClearCase				X		
XRunner				X		
LoadRunner				X		
Xoftware				P		P
MS Office		PLM				
MS Project		PM				
ccMail		PL				
Lotus Notes		PL				
Adobe Acrobat	PL					
PVCS			P			
SQLWindows			P			
Sybase SQL Server			X			
Open Client			PLX			
System Architect				P		
Visual C++		P				
Public Domain Software						
Mosaic	PLX					
Web Genera	X					
Acrobat Reader	PL					
Lotus Notes Applications						
Doc Production Tool					PL	
Data Management Tool					PL	
Tech Talk Tool					P	
Analysts Notebook Tool					PL	
RDBMS Applications						
Automated Requirements Data Base (ARDB)					P	
Interface Analysis Data Base (IADB)					P	
Test Management Data Base (TMDB)					P	
CARA Data Capture						P
ISE User I/F Applications						
Executive Interface					PLX	
Browsers					PLX	

Legend:

X - Sun Solaris Platform , **P** - PC MS Windows Desktop, **L** - PC MS Windows Notebook
M - Macintosh

Exhibit 5.2.2.2-1 ISE Toolbox Tool Status

exact contents of the IIR data which is made accessible via browsing tools will be detailed in the software design documentation generated during the software development life-cycle.

5.2.2.2. Tool Status

The tools described in the sections above include tools which have already been incorporated into the environment, tools under procurement, some leading candidates, tools to be developed, and freeware. Exhibit 5.2.2.2-1 reflects the current status of candidate tools for inclusion in the ISE Toolbox.

5.2.2.1.4.2.4. CARA Data Capture

A CARA Data Capture tool is planned for inclusion in the ISE. This tool, at a minimum, will provide a forum for performing a CARA and storing the associated criticality and risk assessment data.

This need can be satisfied by using the Microsoft Access RDBMS COTS product or Microsoft Word in conjunction with a Lotus Notes database. However, consideration is being given for the development of a configurable client/server application. If schedule permits and necessary development personnel are available, a SQLWindows client/server application will be generated targeted to a SYBASE SQL Server database. This solution would yield a customized interface for performing a CARA and would provide reporting capabilities. It would also allow for user configuration in terms of items assessed, criteria, criteria prioritization, etc.

5.2.2.1.4.3. ISE User Interface Applications

The ISE includes custom interfaces for both browsing data maintained in the IIR and for initiating tools included in the ISE Toolbox. The following sections provide preliminary alternatives for tool solutions.

5.2.2.1.4.3.1. Executive Interfaces

External users will be permitted to logon to both the PC and Sun SPARC server. The executive interface to PC tools included in the ISE Toolbox may be implemented via:

- Microsoft Office toolbar customization,
- SQLWindows application,
- Visual C++ application, or
- if feasible a Mosaic interface.

The executive interface to Unix based tools included in the ISE Toolbox may be implemented via:

- OpenWindows pulldown customization, or
- if feasible a Mosaic interface.

The solution to implementing the interfaces to the ISE Toolbox has notyet been determined. A PC or Sun SPARC alternative will be selected for each platform during the software preliminary design phase.

5.2.2.1.4.3.2. Browsers

The external users of the ISE are permitted access to a subset of IIR information via a Mosaic interface. The interface supports viewing of data in HTML and PDF formats. The majority of the IIR data made accessible is maintained by the EOSDIS IV&V Data Management function. The

5.2.2.1.4.2.3. Test Management Database (TMDB)

The test planning and management functions are combined in a module called the Test Management Database (TMDB), which enables users to define test acceptance criteria, test cases, required resources, and configuration parameters. Detailed testing procedures may also be defined from the TMDB, but are most likely to be maintained as text files rather than relational tables. Part of the TMDB executes on the Test Buddy to provide on-site access to test cases and procedures, test data set identifiers, and test configuration parameters to facilitate setup. During testing, the TMDB supports the capture of observed results as the procedures are executed. Other types of tools directly monitor and capture performance parameters during the test. Following the test, the TMDB supports the analysis of observed or directly monitored parameters against the expected results, for each step in the test procedure. This leads either to verification of the requirements being tested, or the identification and documentation of discrepancies. Exhibit 5.2.2.1.4.2.3-1 depicts the anticipated database interaction for the test management client/server application.

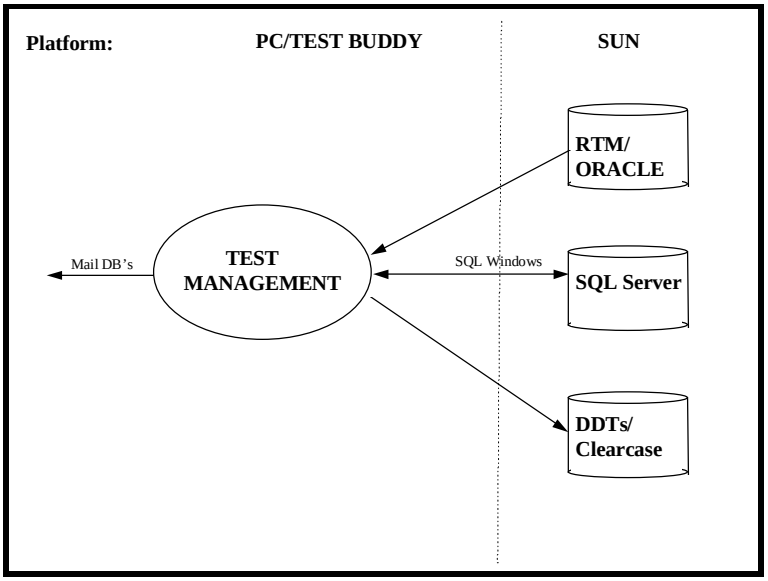

Exhibit 5.2.2.1.4.2.3-1 Test Management Database Interaction

5.2.2.1.4.2.2. Interface Analysis Database (IADB)

The prototype application being developed to satisfy the interface analysis function (refer to section 5.1.1.3) is called the Interface Analysis Database (IADB). It is intended to facilitate the capture and analysis of potentially conflicting interface specifications derived from multiple sources. The tool's graphical user interface facilitates the extraction of interface specifications from various documents, as well as the analysis of those specifications for consistency and completeness. An integrated data dictionary, capable of tracking alias, subclass, and sub-item relationships between data classes, aids in resolving apparent conflicts between interface specifications. The IADB is currently a standalone application, but will eventually support concurrent, multi-user entry and analysis of interface specifications across a local area network. The tool is totally configurable, i.e., all organizations, documents, systems, interfaces, and data item classes can be defined for each project. The tool is written in Microsoft Access, enabling it to be broadly deployed at low cost to execute on existing personal computers. Exhibit 5.2.2.1.4.2.2-1 depicts the anticipated database interaction for the interface analysis client/server application.

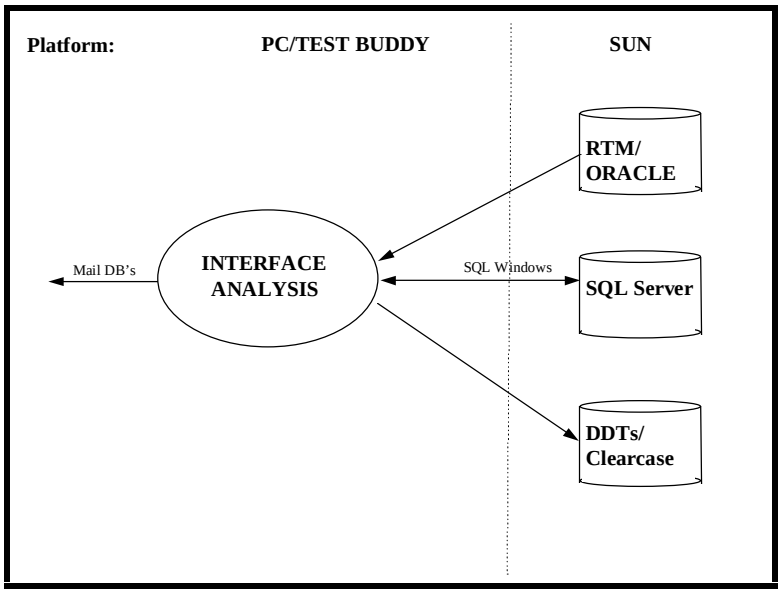

Exhibit 5.2.2.1.4.2..2-1 Interface Analysis Database Interaction

5.2.2.1.4.2.1. Automated Requirements Database (ARDB)

The prototype application which supports the requirements evaluation function (refer to section 5.1.1.1) is called the Automated Requirements Database (ARDB). The requirements evaluation forms and database were developed in Excel. Analytic annotations are incorporated via embedded Microsoft Word documents. The ARDB includes a front end, written in C++, that facilitates access to the various files composing the database via a set of hierarchical menus. The ARDB supports multiple concurrent users via networked access to ARDB files. Only one user at a time is permitted write access to any given file. Exhibit 5.2.2.1.4.2.1-1 depicts the anticipated database interaction for the requirements analysis client/server application.

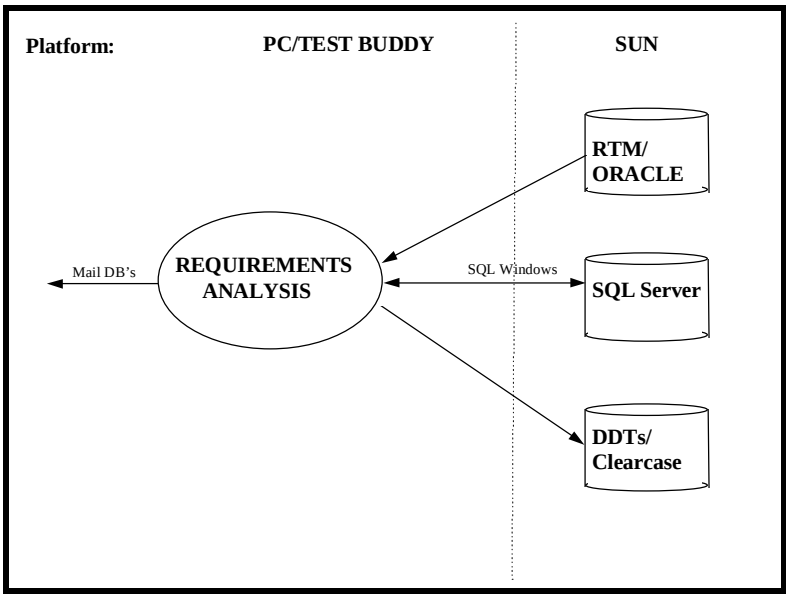

Exhibit 5.2.2.1.4.2.1-1 Requirements Analysis Database Interaction

- The DM Hardware and Software database application stores and manages information on project equipment. It permits information on hardware and software items to be searched and viewed in a variety of ways and supports report generation.

5.2.2.1.4.1.3. Tech Talk

This Lotus Notes database application creates a forum for EOSDIS IV&V team members to share their thoughts, ideas, and questions about a particular software tool and/or application. In particular, the database was created so that team members could document new discoveries and questions regarding the usage of a particular software tool and/or application.

5.2.2.1.4.1.4. Analyst Notebook

This Lotus Notes application acts as a log and contains details from technical analyses. All information pertaining to a particular issue or concern is recorded. Meetings, discussions and information that must be gathered prior to analysis is included. Methodology, data, and results are recorded. This material is used as a valuable source of information for the creation of reports and briefings as well as an aid to future analysis.

5.2.2.1.4.2. RDBMS Client-Server Applications

At least four Toolbox functions may be implemented as relational database management system (RDBMS) client/server applications: 1) requirement evaluation, 2) interface analysis, 3) test planning, and 4) selected test execution, analysis and management functions (specifically, capture of observed test results). All four of these areas lend themselves to RDBMS client-server implementations because of the inherently relational structure of the information they manage combined with the need for multi-user concurrent access.

Prototypes of the requirement evaluation and interface analysis functions have already been developed, and will be used to refine the requirements and designs for the operational versions of these tools. This approach is in compliance with the Spiral Model being followed.

The client/server development that is undertaken will utilize the Gupta SQLWindows product for developing PC applications. The data for applications is targeted to the Sybase SQL Server RDBMS that will reside on the Sun SPARC server.

The Acrobat Reader from Adobe Systems is a companion product to the Adobe Acrobat product. The Acrobat Reader is freeware and provides a viewing capability for files converted to PDF format using the Adobe Acrobat tool. The PDF format is widely supported and is supported by Mosaic. IIR documents which are to be viewed by external users will be converted to PDF files and will be made accessible through Mosaic.

5.2.2.1.3. Operating System (OS) Software

The EOSDIS IV&V has chosen three computer platforms integrated through network connectivity to perform it's tasks. These platforms include Sun, IBM PC, and Macintosh computers. Each platform requires an operating system so that it can support the software necessary for completing IV&V tasks. For the Sun, Solaris 2.3 has been installed. Solaris 2.3 is Sun's most recent release of OS software and is modeled after AT&T's System V Release 4 (SVR4) version of UNIX. Solaris provides the framework to support user account administration, network connectivity, and specific applications supporting IV&V tasks such as, RTM, BONeS, DDTs, and SYBASE. For the IBM platform DOS 6.22 along with Microsoft Windows for Workgroups 3.11 are in use. The DOS/Windows pair provides support for the IV&V office automation tools, the ARDB tool, the IADB tool, and the Novell LAN and WAN network capabilities. MacOS 7.1.2 is being used for our Macintosh platforms to support project planning tools as well as office automation tools.

5.2.2.1.4. Developed Applications

5.2.2.1.4.1. Lotus Notes Applications

Various Lotus Notes applications have been developed specifically for use by the IV&V Task Teams. These applications are detailed in the following subsections.

5.2.2.1.4.1.1. Document Production

The Lotus Notes Document Production application permits a team to participate in the production and editing of a document using MS Word. The application helps manage the version of the document and uses its E-mail capability to communicate information concerning document revisions between team members. The Object Linking and Embedding (OLE) feature that Lotus Notes supports is heavily used.

5.2.2.1.4.1.2. Data Management (DM)

Lotus Notes has been used to develop applications to manage documents, hardware and software.

- The DM Document Library application stores and distributes project documents

5.2.2.1.1.17. Visual C++

Version 1.5 of the Microsoft Visual C++ Professional Edition Development System for Windows provides compilation, debugging, and GUI building capabilities. Additionally, it includes the industry standard Microsoft Foundation Class Library with OLE and database class enhancements. This product provides the utmost flexibility in developing PC Windows applications.

5.2.2.1.2. Freeware and Public Domain Software

5.2.2.1.2.1. Mosaic

Mosaic is a browsing interface to information found on the Internet. Mosaic is one of a number of browsers and constitutes a large portion of World Wide Web browsers. The World Wide Web (WWW) consists of 'Home Pages' residing on computing systems distributed around the world that are connected by the Internet. Mosaic provides an excellent means for the EOSDIS IV&V project to disseminate information about it's programs to varying levels of users including IV&V analysts, IV&V organizations, other EOSDIS IV&V personnel, and the general public. Issues such as security and keyword searching are built-in capabilities of 'Home Page' design through the facilities of an Http server. A Home page is an individual's or an organizations opening GUI to the information that is to be made available via the WWW. Home Pages are customizable, make use of multiple media forms, allow hypertext, and can be created by virtually any user. An Http server is the server side of the client server architecture for which Mosaic and other browsers provide the client role. Both Mosaic and Http servers are available on a large multitude of platforms that give them wide credibility as a tool to service the information needs of the general computer user community.

5.2.2.1.2.2. Web Genera

In simple terms, Web Genera provides a front-end interface between a Mosaic browser and SYBASE databases. Genera originally was developed to address maintainability issues in the software development process paradigm for the USDA's Plant Genome project. Genera at that time was based on SYBASE's APT-Forms and provided a simple user interface for inputting database specifications in a forms-oriented manner; as the user wants them to appear rather than in some underlying database or physical schema. In 1993 the NSF provided funding to develop a more robust version of Genera and a recent decision has been to use Mosaic as the Genera front-end. This decision was made primarily because Mosaic supports most of the features Genera plans to support with the fill-out forms capability. Another feature that made Mosaic an attractive choice as a front-end was the separation of critical and interesting functionality from a closed system that could hinder future portability and reuse.

5.2.2.1.2.3. Acrobat Reader

archive of project components that can be centralized or distributed. This product automatically determines dependencies and updates the build script with current version numbers.

PVCS will provide the primary means for performing CM during the development of the ISE. It integrates nicely with other ISE development tools including SQLWindows and Visual C++.

5.2.2.1.1.14. SQLWindows

SQLWindows product is a client/server development system used to develop client/server database applications. The application produced for the PC/Windows environment is a Windows application which can access multiple databases over a LAN or WAN architecture. This tool provides a highly automated development environment which simplifies the development of the Graphical User Interface (GUI) and database manipulation. This class of development tool also simplifies remote database connectivity to the extent that it is seemingly transparent to the developer. Extensive reporting capabilities are also provided. Development features include:

- Support for Object Linking and Embedding (OLE), Dynamic Data Exchange (DDE) and Visual Basic Extensions (VBX)
- Interfaces to Lotus Notes and cc:Mail
- Team development using TeamWindows
- Integration with PVCS
- Built-in database routers for Oracle, Sybase SQL Server, etc.
- Support for C and C++ via a C Application Programming Interface (API)
- Macintosh support planned for early 1995

5.2.2.1.1.15. SYBASE SQL Server

SYBASE SQL Server is a relational database for on-line applications. The fundamental difference between SYBASE relational database products and other systems is the SYBASE Client/Server Architecture. This architecture performs multi-tasking within its own database kernel. Because of this, SYBASE SQL Server minimizes operating system overhead and supports up to ten times as many users as other systems. Another reason for selecting SYBASE as the database back-end for client/server development is that an interface has been developed, Web Genera, allowing SYBASE table data to be displayed through Mosaic.

5.2.2.1.1.16. System Architect

System Architect Version 3 from Popkin Software is a powerful and affordable CASE tool for developing client/server, MIS, and real-time applications. It supports numerous planning, analysis, and design methodologies inclusive of both structured and object oriented methods. In developing the ISE, the base product, schema generator, and SA Object module will be used during analysis and design activities.

5.2.2.1.1.9. Microsoft Project

Microsoft Project Version 4.0 is a project planning application that allows users to create project plans, communicate them to others, track actuals versus planned data, and manage schedule changes as they occur. Various reporting capabilities are provided.

5.2.2.1.1.10. cc:Mail

The PC environment on the ISE network uses cc:Mail from Lotus to exchange electronic mail between all users on the ISE network as well as any user on the Internet.

5.2.2.1.1.11. Lotus Notes

Lotus Notes Version 3.0 is a groupware tool providing information management capabilities for workgroups. Users can share information across a local network or remote sites. Lotus Notes can be used to collect information from a variety of sources to build an organized database. It allows information to be shared among users, provides support for workflow management, and permits development of custom Lotus Notes applications.

5.2.2.1.1.12. Adobe Acrobat

Adobe Acrobat is a tool from Adobe Systems which manages documents and provides access to documents in their original form independent of platform. It provides full-text searching across multiple documents and uses a common format for electronic document storage regardless of the original document format. This software will be used to convert all deliverable documents to the PDF format for external user viewing. PDF viewer or reader software is free and is compatible with Mosaic. The PDF format in conjunction with Mosaic and the Acrobat Reader will provide the necessary capabilities for the external users to view IIR documentation.

5.2.2.1.1.13. PVCS

PVCS is one of the most widely used and relatively low-cost SCM product families. It supports heterogeneous network configurations including PCs running MS-DOS/Windows and SUN SPARCstations running Solaris. PVCS is developed and maintained by Intersolv of Rockville, Maryland. The PVCS product family includes Version Manager which tracks and controls individual software modules and application versions in distributed environments during development and maintenance. It supports distributed file access and a single format, file locking for concurrent access to objects, security facilities to control user access permissions, and version branching and merging for parallel development. The SQL Export product populates the SQL tables with PVCS information for industry standard SQL database products including Oracle and Sybase. The PVCS Configuration Builder automates the system build process, maintaining an

LoadRunner from Mercury Interactive is an automated testing system for multi-user Unix X applications. LoadRunner falls under the "emulator" tool classification and is particularly well suited to client/server systems. LoadRunner tests system functionality and response under load conditions. It accurately replicates real-life use of a system by emulating multiple users running in parallel. Many users can run together on the same machine or hundreds of users can be distributed on several machines. They may all be directed from a single station. LoadRunner features include:

- Load testing with multiple emulated users
- Accurate and flexible performance measurement
- Centralized control of distributed testing
- Graphs and reports for data analysis

5.2.2.1.1.7. Xoftware

Xoftware from AGE Logic, Incorporated provides an X terminal capability on the PC platform so that the Unix based applications on the Sun SPARC server are accessible to the PC user.

Implementing PC X servers is a cost effective alternative when comparing the software licensing costs to that of X terminal hardware. Incorporating this PC X software will minimize the need for additional X-terminals. The known disadvantage of using a PC X server is that of performance as compared to the X-terminal. Of all the PC X servers, the Xoftware/32 package edged out the other leading candidates in terms of performance and was found to be quite responsive. AGE Logic is also in alpha test of an X capability for the Macintosh, even though no Xserver needs have been identified to date.

5.2.2.1.1.8. Microsoft Office Pro

Microsoft Office Pro is an office automation toolsuite consisting of an integrated family of applications. These applications include the following:

- Excel version 5.0a is a comprehensive spreadsheet application that lets users manage, format, chart, and analyze data.
- Word version 6.0a is a full featured word processor that includes automatic formatting, creation of tables, and the ability to create and position graphics.
- PowerPoint version 4.0a is a complete presentation graphics package that allows for the creation of fully formatted slides and presentations.
- Access version 2.0 is a relational database management system that lets users store, organize, and easily retrieve information.

Security measures for controlling access to data and administrative functions are integral with the system. Most functions of DDTs are user configurable through script files, that make the system flexible to meet most any project needs.

The current release of DDTs, Version 3.1.11, uses a flat ASCII file database. Version 3.2 should be available in the first quarter of 1995. This will have an SQL interface to an internal relational database. Version 4.0 should be released in the fourth quarter 1995 which will have open access to any SQL based database system, such as Oracle or Sybase

The DDTs system has been used at Hughes Aircraft in support of NASA projects since 1993, and has been recommended by Hughes for use in the ISE system.

5.2.2.1.1.4. ClearCase

ClearCase is a leading Software Configuration Management (SCM) product developed and maintained by Atria Software of Natick, Massachusetts. ClearCase provides a choice of command line or Motif GUI and makes the SCM function almost entirely transparent to the UNIX developer and other tools. ClearCase can manage all types of objects providing version control with automatically recorded change history, user-defined attributes including version annotating, rule-based environment management and process control facilities. A query facility allows developers to search for files or configurations based on any attributes. ClearCase supports version branching for parallel development and platform variants, and provides a multi-way compare and merge tool which records merge points as part of the change history. ClearCase also supports configuration baselining and reusability by maintaining a shared pool index of compiled objects so a build operation can take advantage of shared object files built by other developers. Managed files may be stored on multiple nodes in a network, including servers and hosts that are not running ClearCase software. To support process management, ClearCase provides pre- and post-event triggers which monitor ClearCase operations, and fire specified actions when the monitored events occur. The action may be one of several built-in ClearCase actions including lock and access controls, branch creation, or rule-based queries. ClearCase is tightly integrated with QualTrack's DDTs problem tracking software.

5.2.2.1.1.5. XRunner

XRunner from Mercury Interactive automates user operations associated with GUI testing. XRunner falls under the "capture/playback" tool classification and includes automation support capabilities for GUI objects, mouse tracks, keystrokes, display output, or underlying application activity. Tests are recorded as fully programmable test scripts; played back, they run as though a human user were at the controls. You get reliable unattended verification with fast, accurate, and repeatable results.

5.2.2.1.1.6. LoadRunner

functions as the identification of orphan requirements, and the analysis of direct and indirect relationships between requirements, design elements, and other types of information.

A key factor in selecting RTM for the ISE was its selection by the ECS and EDOS development contractors, and by the ECOM IV&V contractor. Although RTM is reasonably well suited to the management of requirements, user interface characteristics limit its utility as a generalized information management tool. We have thus chosen to develop selected RDBMS applications for certain other functions (e.g., interface analysis and test management). The ISE architecture calls for the exporting of requirements from RTM to selected other applications to enable the linking of requirements to interface specifications, test cases, and other types of information.

5.2.2.1.1.2. BONeS

The Block Oriented Network Simulator (BONeS) product is a marketed by the Alta Group of Cadence Design Systems, Incorporated. The BONeS product provides capabilities for simulation model design, execution, and analysis. The BONeS product family includes:

- the BONeS Designer,
- the Interactive Simulation Module,
- the Network Performance Analysis Modules, and
- the BONeS PlanNet.

5.2.2.1.1.3. DDTs

The Distributed Defect Tracking System (DDTs) is a Unix based change management and bug tracking system, developed by Qualtrak, that tracks and manages changes throughout the life cycle of a hardware or software project. The system supports tracking of the following:

- Software problems - for tracking software defects
- Software Change Proposals - for tracking Change Proposals made up of multiple software defects
- Hardware problems- for tracking hardware defects
- Calls - for tracking telephone calls for support
- Companies - for the logging of defect reports against third party developers of software or hardware components of the system
- Requests - for tracking System Administration and Facilities requests
- Issues - for general issues tracking
- To Do - for organizing and tracking things to be completed on a system before release that are not classified as defects

DDTs provides scaleable project size support and is integrated with multiple configuration management systems including Atria's ClearCase to allow for formal change and configuration management. Additionally, the DDTs system supports network wide submission of defects along with a wide array of reporting, searching and querying tools.

5.2.1.3.2. Open Client

Open Client is a product produced by Sybase, Incorporated for providing network access to a Sybase SQL Server RDBMS.

5.2.2. ISE Toolbox

The ISE Toolbox defines tools and applications which satisfy the functions which must be supported by the ISE. With the exception of those tools discussed or covered under section 5.2.1, Network/Computational Infrastructure, the following subsections provide a brief description of each tool that is probable for inclusion in the ISE Toolbox. In addition to the tool descriptions, subsections also discuss the procurement status of the tools described and a mapping of tools to functions.

As progress against the active IV&V tasks is made or as new IV&V tasks are identified, additional tool requirements may be levied on the ISE. For example, when test planning or test execution activities are initiated, it is likely that additional testing tools will be identified for inclusion in the ISE. Other instances like this may also occur when the IV&V analysts become entrenched in design and code analysis activities. New tool requirements are anticipated for the tool classes identified within the following functional architecture sections:

- 5.1.1.5, Design Analysis
- 5.1.1.6, Code Analysis
- 5.1.1.8, Test Execution, Analysis and Management

5.2.2.1. Tool Descriptions

Tool descriptions provided in the following subsections are categorized by:

- COTS tools,
- Freeware and Public Domain Software,
- Operating System Software, and
- Developed Applications.

5.2.2.1.1. COTS Software

5.2.2.1.1.1. RTM/Oracle

Requirements Traceability Management (RTM) is a COTS product for defining requirements, other types of information, and their interrelationships (e.g., traceability between parent and child requirements). RTM enables users to define the types of information and interrelationships to be managed, and automatically configures the user interface accordingly. RTM provides such basic

5.2.1.2. Communications

In order for electronic communication to occur between network users, regardless of location, communications software must be used in conjunction with the network components discussed above. The following sections discuss the software that is used to enable electronic communications.

5.2.1.2.1. Electronic Mail

Lotus cc:Mail is used to exchange electronic mail from PC and Macintosh workstations. Sendmail (the standard mail utility for Unix operating systems) is used to exchange mail from X-terminals. Mail may be exchanged between all users on the ISE network as well as with any user on the Internet. File attachments are supported from either environment.

5.2.1.2.2. File Transfer

In addition to electronic mail file attachments, files may be transferred using the File Transfer Protocol (FTP). FTP is supported by LAN WorkPlace for DOS on the network's PC environment. This software package also provides ISE network users with direct access to a broad range of dissimilar computing resources using the TCP/IP suite. FTP is also supported by the Unix environment on the network due to Unix's built in support of TCP/IP software.

5.2.1.2.3. Mobile Communications

Mobile users will also have the ability to communicate with the ISE network from remote locations. Laptop computers equipped with a data modem and communications software will be able to dial-in to either network. After a mobile user has successfully logged in to the network, he or she may then access network data, transfer data, or send and receive electronic mail.

5.2.1.3. Client-Server Applications

The network infrastructure also provides tool support for accessing two Relational Database Management Systems (RDBMS) by client/server applications. Both Sybase SQL Server and Oracle are resident on the Sun SPARC Server.

5.2.1.3.1. SQLNet

SQLNet is a product produced by Oracle Corporation for providing network access to an Oracle RDBMS.

sites. A T1 line (1.544 Mbps) is used between Fairmont, WV and GSFC. A 56 Kbps line is used between Greenbelt, MD and GSFC.

AppleTalk, a Macintosh communications protocol, is used to enable network communications between Macintosh computers on the Greenbelt, MD LAN. An AppleTalk bridge enables communications between the AppleTalk network and the rest of the LAN. The Fairmont, WV LAN does not employ the use of AppleTalk since it only has one Macintosh computer. Another unique feature to the Greenbelt, MD LAN is the use of a Proteon P 4200 router which provides connectivity to the Intermetrics corporate network.

5.2.1.1.1.1.4. Printers

A 600dpi laser printer is connected to each local area network. The printer is accessible from all workstation platforms.

5.2.1.1.1.2. Software Components

Software is used to direct the operation of the network hardware components. Separate network operating system software is used for each file server/workstation platform.

5.2.1.1.1.2.1. PC Software

NetWare 3.12 is used as the network operating system for the PCs on the network. NetWare controls the operation of the PC file server (management of disk access, file storage, and memory utilization) and works in conjunction with each workstation PC operating system to provide access to network resources. NetWare also controls file server security as well as user access to the network.

5.2.1.1.1.2.2. Unix Software

The Unix environment on the network uses TCP/IP software to control networking activities between the Sun file server and the X-terminals. TCP/IP software is included as part of the Unix operating system. Thus, the Unix operating system performs much of the same functionality as NetWare does for the PC environment.

HARDWARE ELEMENT, LOCATION (QUANTITY)	DESCRIPTION	FUNCTION
Intermetrics Corporate Network Router, Greenbelt (1)	Proteon P 4200	• Provide connectivity for Greenbelt Ethernet backbone to Intermetrics Corporate Network
PSCN Router, Fairmont (1)	Supplied by NASA	• Provide connectivity for Fairmont Ethernet backbone to NASA PSCN T1 line to GSFC

Exhibit 5.2.1.1.1-1 Hardware Descriptions (continued)

5.2.1.1.1.1. Hardware Components

Hardware components include servers, workstations, connection equipment (network communications systems), and printers.

5.2.1.1.1.1.1. Servers

The network infrastructure of the ISE utilizes two types of file servers (Unix and DOS). A 486-DX2, 66 MHz PC is used to service PC and Macintosh workstations at both sites. In Fairmont, WV, a Sun Sparc 1000 is used to service X-terminals. In Greenbelt, MD, a Sun Sparc 20 is used to service X-terminals. No other servers have been implemented.

5.2.1.1.1.1.2. Workstations

Three hardware platforms are used as network workstations: 486-DX2, 66MHz PCs, Macintosh computers and X-terminals. PCs will be the primary workstation for ISE users. However, each PC will be equipped with PC-X software permitting access to network-based Unix applications. Macintosh computers will primarily be used to perform administrative functions.

5.2.1.1.1.1.3. Network Communications System

The network hardware components are connected using a star topology as part of a 10BaseT Ethernet LAN. Connectivity between Fairmont, WV and Greenbelt, MD is accomplished through the use of PSCN routers and wide area connection lines. Each LAN has connectivity to the Goddard Space Flight Center which establishes a link between the two geographically dispersed

HARDWARE ELEMENT, LOCATION (QUANTITY)	DESCRIPTION	FUNCTION
Network Printer, Greenbelt (1) and Fairmont (1)	HP LaserJet 4Si • 25MHz RISC processor • 17 ppm • 600 dpi	• Network printer servicing all workstation platforms (i.e. PC, X-terminal, Macintosh)
Printer, Fairmont (1)	HP LaserJet 4MP • 6 MB RAM • 4 ppm • 600 dpi	• Services a single designated PC • Used primarily for administrative tasks
AppleTalk Bridge, Greenbelt (1)	Telephone wire	• Provide network communication from Ethernet backbone to AppleTalk network
AppleTalk Network, Greenbelt (1)	Telephone wire	• Provide Network communication between Macintosh computers
10BaseT Ethernet LAN, Greenbelt (1) and Fairmont (1)	Unshielded Twisted Pair (UTP) Network Cable	• Provide network communication for PC and X-terminal clients to Servers through the Ethernet backbone
Ethernet Backbone, Fairmont (1)	Fiber Optic Cable	• Provide network communication between routers, servers, 10BaseT Ethernet LAN, and Macintosh computer
Ethernet Backbone, Greenbelt (1)	Thin Coaxial Cable	• Provide network communication between routers, servers, 10BaseT Ethernet LAN, and Macintosh network
Modem Server, Greenbelt (1) and Fairmont (1)	TBD	• Provide remote dial-in access to Unix Server and PC Server
PSCN Router, Greenbelt (1)	Supplied by NASA	• Provide connectivity for Greenbelt Ethernet backbone to NASA PSCN 56 Kbps line to GSFC

Exhibit 5.2.1.1.1-1 Hardware Descriptions (continued)

HARDWARE ELEMENT, LOCATION (QUANTITY)	DESCRIPTION	FUNCTION
DOS PC, Greenbelt (29) and Fairmont (10)	Gateway P4D-66 • Intel 486DX2 66MHz processor • 16 MB RAM • 540 MB HD • CD ROM • 3.5 inch floppy drive • 17 inch color monitor	• Personal computer for office automation software, desktop publishing, word processing, and electronic mail • May serve as an X-Window client terminal
Macintosh Computer, Greenbelt (4) and Fairmont (1)	Power Macintosh 6100/60 AV • 16 MB RAM • 250 MB Internal HD • CD ROM • 3.5 inch floppy drive	• Personal computer for office automation software, desktop publishing, word processing, and electronic mail
Macintosh Computer, Greenbelt(1)	Duodock	• Personal computer with removable laptop for office automation software, desktop publishing, word processing, and electronic mail
Macintosh Computer, Greenbelt(1)	Macintosh LCIII	• Personal computer for office automation software, desktop publishing, word processing, and electronic mail
Macintosh Laptop Computer, Greenbelt (1)	Macintosh Powerbook 170	• Personal computer for office automation software, desktop publishing, word processing, and electronic mail
DOS Laptop PC, Fairmont (2)	AST Ascentia 800N • Intel 486DX2 50MHz processor • 20 MB RAM • 250 MB HD • 3.5 inch floppy drive • 14.4 PCMCIA data/fax modem card PCMCIA Ethernet LAN adapter card	• Personal computer for office automation software, desktop publishing, word processing, and electronic mail

Exhibit 5.2.1.1.1-1 Hardware Descriptions (continued)

HARDWARE ELEMENT, LOCATION (QUANTITY)	DESCRIPTION	FUNCTION
Unix File Server, Fairmont (1)	SUN Sparc 1000 • 1 GB Internal HD • 4.2 GB Hard Drive • 128 MB RAM • 4MB NVRAM • CD ROM • 4mm tape drive • SCSI buffered ethernet • Solaris 2.3 OS	• File server for the X window terminals • Support tool development • Processor for Unix based tools and applications • Central Repository for IV&V data, documentation, and information • Access control • Configuration management • Support Unix based communication across WAN
Unix File Server, Greenbelt (1)	SUN Sparc 20 • 2.1 GB HD • 64 MB RAM • CD ROM • 4mm tape drive • SCSI buffered ethernet	• File server for the X window terminals • Processor for Unix based tools and applications • Local Repository for IV&V data, documentation, and information • Access control • Support Unix based communication across WAN
X-terminals, Greenbelt (8) and Fairmont (3)	HDS View Station • 20 inch color monitor • 8 MB RAM • SUN5 Keyboard	• Terminal client for X-Window based applications
DOS PC Server, Greenbelt (1) and Fairmont (1)	Gateway P4D-66 • Intel 486DX2 66MHz processor • 40 MB RAM • 1 GB Internal HD • CD ROM • 3.5 inch floppy drive • SCSI Controller 15 inch monitor	• File server for DOS PCs and Macintosh computers • Processor for DOS based tools and applications • PC access control • Support Novell NetWare based communication across WAN

Exhibit 5.2.1.1.1-1 Hardware Descriptions

among network users. A description of each ISE network component, that includes the quantity and location of each component, the hardware specifications, and the functionality, is contained in Exhibit 5.2.1.1.1-1. Each of these components is also briefly discussed below.

5.2.1.1. Network Configuration

The following sections will describe the components which comprise the network infrastructure of the Integrated Support Environment. As mentioned in the preceding section, similar configurations will exist in both the Fairmont, WV and Greenbelt, MD locations. However, the discussion that follows will describe the network components with respect to a single local area network. Any differences between the configurations at the two locations will be mentioned below. Otherwise, it may be assumed that the configurations are the same. A diagram of the ISE network/computational infrastructure is provided in Exhibit 5.2.1.1-1.

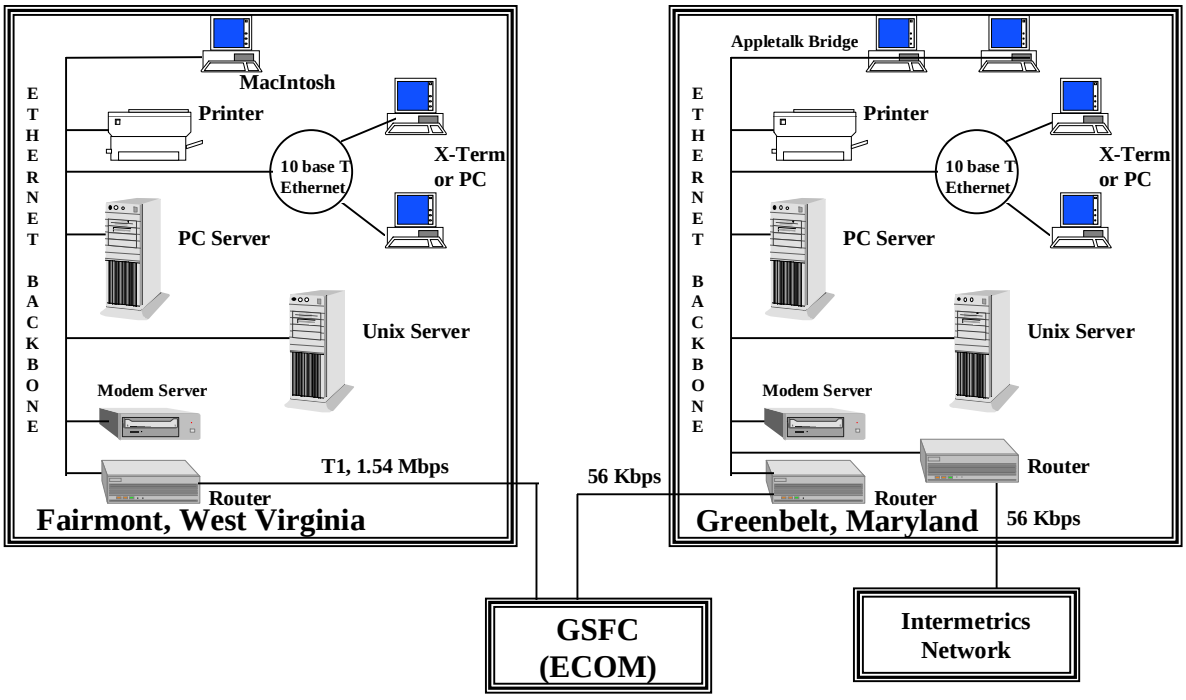

Exhibit 5.2.1.1-1. Network/Computational Infrastructure

5.2.1.1.1. Network Components

As with any network, its configuration can be described in terms of both hardware and software components. The interaction of these components provides the ability to share resources and data

5.1.2.3. Database Management

The database management function enables the storage of and access to relational and nonrelational data. Access is controlled at the database, table, and record levels. The database management function potentially supports several of the Toolbox functions, including requirements evaluation, traceability analysis, interface analysis, test planning, and test execution, analysis and management.

5.1.2.4. File Management

File management enables the storage of and access to files of various types. Access is typically provided to the file level. All Toolbox functions are supported by the file management function, as it is inherently supported via the operating system (OS) for each ISE platform.

5.2. Physical Architecture

5.2.1. Network/Computational Infrastructure

The design of the network infrastructure for the Integrated Support Environment is influenced by several factors. These design factors include user needs, location, communications, consistency, maintainability, and expandability. First and foremost, the network infrastructure must meet the needs of the ISE user community, regardless of location. This includes users at both the Fairmont, WV and Greenbelt, MD locations, as well as mobile users. Therefore, access to a particular tool or database is independent of location. This requires the infrastructure at both locations to be consistent and similar in design and implementation, thus promoting maintainability. The network infrastructure is also designed to provide the ability to communicate locally as well as between the two dispersed locations. Mobil users will also have the capability to dial-in to either network. Lastly, the network infrastructure is designed to accommodate changes and expansion due to changing user needs or technological advances.

The computational design is primarily influenced by the scope and nature of the IV&V tasks to be performed as well as the tools that are needed to perform those tasks. In addition to the current computational needs, consideration is given to expansion in terms of processing capabilities and storage.

5.1.1.15. Equipment Management

The IV&V contractor is required to manage the location and status of all government-furnished equipment (GFE) at all times. The ISE supports this requirement with an on-line data management function including support for tracking both software and hardware elements.

5.1.1.16. Analyst's Notebook

The ISE provides an on-line technical interchange forum, referred to as the Analyst's Notebook, to encourage communication and synergy between IV&V personnel. Justification for supporting this function comes from the lengthy duration of the EOSDIS IV&V contract. Thus, when personnel transitions on and off the EOSDIS project, data that is not captured in formal deliverables or other databases is maintained for potential applicability to on-going activities.

5.1.2. IIR Functions

To complement the functions of the Toolbox, the ISE IIR provides several major functions required for the management of information. These functions are described in the following paragraphs.

5.1.2.1. Configuration Management

Configuration Management (CM) enables the controlled access to, and manipulation of multiple versions of a given document or file. With regards to file level CM, it is applicable to files critical to the certification of executable modules. These files may include the executables themselves, test scripts, test data, etc. A CM function must also be supported by the ISE during the incremental development of the ISE.

5.1.2.2. Document Management

In conjunction with the document navigation and browsing function, the ISE includes a document management function responsible for document cataloguing, configuration management, access control, and configuration control. Cataloguing involves maintaining an organized index of all documents managed within the ISE to facilitate their location by users. Configuration management prevents confusion resulting from the concurrent management of multiple versions of a given document. Access controls permit only authorized users to read or modify each document. Configuration control is a specialized form of access control in which modifications to a document are permitted only upon the approval of a designated organization, and are accomplished by an authorized representative.

5.1.1.12. Criticality Analysis and Risk Assessment (CARA)

A CARA is a decision aide employed by the Intermetrics EOSDIS IV&V Team for a number of purposes. Criticality refers to the potential impact of a problem, while risk addresses the likelihood of problem occurrence. Possible objectives for performing a CARA may include:

- facilitating identification of EOSDIS risk elements,
- guiding the focus and scope of multiple on-going IV&V analyses,
- prioritizing work elements for IV&V analysis, and
- focusing IV&V resources for cost effectiveness.

The ISE must support this function by providing tools adequate to perform a CARA and produce related reports. This support could come in the form of making COTS products available (i.e. Microsoft Access, Microsoft Excel, .etc.) or by implementing a custom tool to support CARA activities for the duration of the contract.

5.1.1.13. Activity Scheduling

Activity scheduling involves the definition of a set of activities to be performed, definition of activity durations, resource requirements, resource interdependencies, and generation of a schedule (usually depicted graphically). The EOSDIS IV&V contract uses the activity scheduling function in at least two distinct contexts: 1) to track and analyze government-provided project schedules to identify potential impacts on IV&V processes and schedules, and 2) to schedule tests based upon externally defined schedules detailing resource availability. The ISE provides an activity scheduling function to support these needs.

5.1.1.14. ISE Development and Administration

An ISE Development and Administration function is necessary in the construction of the ISE. In order to establish the ISE, various tools are required. These tools would include those similar to any development environment (i.e. CASE tools, compilers, debuggers, etc.). During ISE development and once the first incremental release of the ISE is made, the ISE must support an ISE administration function so that the tools, data, and network/computational infrastructure may be maintained effectively for the duration of the IV&V contract. In addition to providing the necessary personnel to perform this administration activity, various tools and training may be required. Tools needed for ISE administration may include:

- network analyzers,
- disk utilities,
- surge protectors, and
- system backup tools.

provide feedback to the developers as early as possible in the development life cycle when potential problems are least costly to correct. Interface analysis and system modeling and simulation could be considered to be elements of design analysis, but design analysis will involve other functions. Design analysis is used here as a place holder for specific functions and tools that will be identified and selected over time.

Two classes of tools which can be used during design analysis include complexity measurement and structure checkers. Several complexity measurement and structure checking tools avail themselves for accepting pseudocode. Analysis of the pseudocode design language can help identify requirements not being addressed by the design and design components which may be too complex for acceptance due to likely maintenance costs. Additional tools which may be used for design analysis include:

- requirements analyzers,
- requirements tracers (e.g. RTM), and
- design CASE tools.

5.1.1.11. Code Analysis

IV&V code analysis can yield valuable feedback to the developers regarding the quality of the code being produced, potential performance bottlenecks, and potential integration issues derived from structural or behavioral incompatibilities between modules. Code analysis functions generally fall into two major categories: dynamic and static. Dynamic code analyses are those that involve the execution of the code to analyze its behavior and are done in the later phases of analysis if the host and platforms are available. Static code analyzers examine source code without executing it and extend the analysis performed by compilers. Two categories of static analysis are available, manual static analysis and automated static analysis. Manual techniques include: code inspections, reviews, walkthroughs, and desk-checking. This technique is very person intensive, time consuming, and targets either small program or critical modules of a larger program. The automated techniques encompasses numerous tool categories enabling analysis of much larger programs though not as specifically intensive. These categories include but are not limited to:

- auditors,
- complexity measurers,
- cross referencing tools,
- size measurers,
- structure checkers,
- syntax/semantics analyzers, and
- reverse engineering tools.

availability of test plans, test procedures, test tools and office management tools such as Microsoft Project®.

The ISE may provide several classes of test tools including:

- Capture-Replay (e.g. Xrunner),
- Emulators (e.g. LoadRunner),
- Network Analyzers,
- Performance/Timing Analyzers, and
- Data Reducers and Analyzers.

5.1.1.8. Discrepancy Tracking and Reporting

Throughout a system's development life cycle, developers, analysts (IV&V practitioners) and users generate reports documenting actual or potential discrepancies among system requirements, design, implementation, and test execution. At least three different types of discrepancy reports (DRs) are relevant to the ISE: 1) discrepancy reports on the EOSDIS generated by the IV&V team, 2) discrepancy reports on the EOSDIS generated by developers and users, and 3) discrepancy reports on the ISE generated by its users. The ISE facilitates the generation, tracking and accessing of discrepancy reports via on-line services.

Discrepancy report generation will be supported via tools included within the ISE. Once generated and approved for submission, support will exist for storing approved DRs. This database function will provide a basis for tracking and reporting. Conceptually, various levels or categories of problems (i.e. software problems, document problems, action items, etc.) could be identified for tracking and reporting. Various categories of problems must also be supported by the ISE.

5.1.1.9. System Modeling and Simulation

The ISE supports verification and validation of the evolving EOSDIS design through a modeling and simulation function capable of predicting various performance parameters based upon specified operating conditions. By varying the input parameters, analysts can determine the expected range of performance parameters for a given design, taking into account the uncertainties associated with various inputs. The modeling and simulation function allows the IV&V team to import the developer's system models, analyze those models for compliance with requirements, and execute the models using independently derived input parameters. The results are then compared with the developer's, and significant discrepancies are investigated and resolved.

5.1.1.10. Design Analysis

The design analysis function involves a host of specific requirements for evaluating the quality, performance, reliability, and other characteristics of the system design. The objective is to

systems. A critical aspect of the IV&V process is to assure the consistency and completeness of all interface specifications on both local and end-to-end bases. This requires agreement upon the precise types of the information to be interchanged between any two systems, as well as the transmission rate, frequency, format, medium, and other such specifications for the interchange of each type of information.

Because of the numerous organizations, documents, interfaces, and data types involved, the ISE aids analysts in recording interface specifications from various sources, and in analyzing them for consistency and completeness. This involves the definition of a hierarchy of documents, interfaces, data items, and specifications, linking of data item specifications to source requirements, and the creation and maintenance of a dictionary of data item names. The dictionary aids in managing naming conflicts resulting from the use of aliases, data item decomposition, and specialization of names.

5.1.1.6. Test Planning

Test planning is the design of test plans, procedures and schedules to verify and validate all system requirements, identifying the resources (e.g. personnel, equipment, test data sets, etc.) needed to conduct the tests and prioritizing the tests according to criticality and risk. Test planning also uses the following data produced by traceability analysis:

- Analysis of peer-to-peer traceability links between requirements to determine reusability of test planning data, and
- Analysis of hierarchical links between requirements to determine test coverage.

The ISE supports test planning through browsing of requirements, criticality/risk assessments, defining or reviewing verification criteria, defining test cases top verify selected requirements, and defining and assigning required resources.

5.1.1.7. Test Execution, Analysis and Management

Test execution includes the execution of test plans, performing the tests according to the test procedures and recording the results. The ISE supports test execution through the use of the Test Buddy and test tools.

Test analysis is the analyzing and interpreting of the test results as well as document findings of the analysis. The ISE supports test analysis by providing on line the test results along with the requirements and all other supporting documentation required to perform the analysis. The test tools provided by the ISE enhance the system's analysis capability.

Test management is the allocation of resources (hardware, software, personnel, etc.) to meet the test plan schedules, revising the schedules as required, maintaining and distributing the results of the tests and analyses. Test management may require the development or configuration of special test software and special test hardware. The ISE supports test management through on line

document navigation and browsing function. This enables IV&V users to traverse a network of on-line holdings to access the most current available versions of relevant documents. These include requirements documents, interface control documents, operations concepts, design documents, project plans, and other documents associated with the EOSDIS and relevant external systems.

5.1.1.3. Traceability Analysis

One aspect of requirements evaluation is to assess upward, downward, and peer-to-peer traceability links between requirements, to assure that all top-level requirements are fully mapped into lower level requirements, and to assure that all lower-level requirements are justified by higher level requirements. Peer-to-peer traceability links aid in analyzing requirements at a given level for internal consistency and completeness, analyzing repercussions of changes, and defining efficient test plans and test cases. Traceability analysis is also used in a more general sense to track the mapping of requirements to design elements, assure adequate coverage of requirements by test cases, and many other applications involving relationships between different types of information.

The ISE provides a generalized traceability analysis function to support the generation, review, and utilization of traceability links not only between requirements, but between other types of information as well. This function enables the identification of all items not related to another set of items, as well as all items related to one or more other items. This function indirectly supports requirements evaluation, interface analysis, and test planning, as well as possible other functions in the future.

5.1.1.4. Requirements Evaluation

Each EOSDIS requirement at levels 2, 3 and 4 is evaluated in terms of three technical integrity criteria: 1) traceability, 2) quality, and 3) testability. Associated with each evaluation is an engineering rationale to substantiate the assigned rating. The purpose of the evaluation is to promote the definition of complete and robust requirements and to avoid subsequent problems whenever possible.

Because of the number of requirements to be evaluated, and the fact that the requirements will evolve over time, the ISE requirements evaluation function assists analysts in browsing requirements, reviewing evaluation criteria, accessing the traceability analysis function, recording evaluations, identifying requirements with low ratings, and generating reports on the analysis.

5.1.1.5. Interface Analysis

The EOSDIS consists of three major components, each consisting of multiple elements and systems. Numerous interfaces exist between these elements and systems, as well as with external

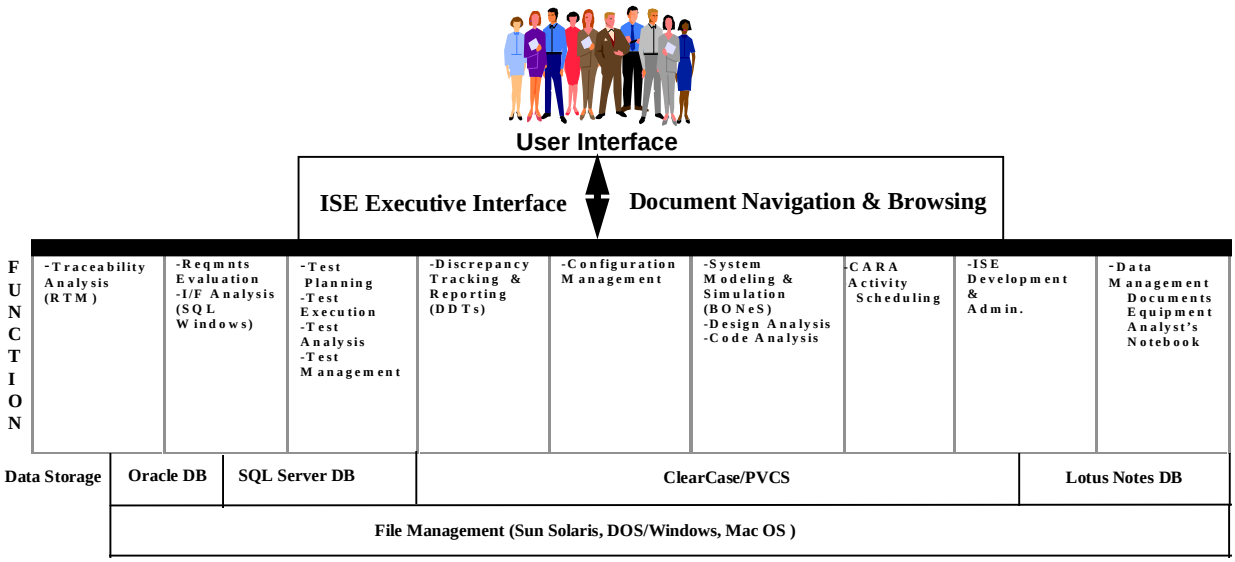

Exhibit 5.1-1 Functional Architecture

5.1.1. ISE Toolbox Functions and Data Flows

The major functions supported by the ISE Toolbox are described in the following paragraphs.

5.1.1.1. Executive Interface

The ISE constitutes a collection of tools and data; each tool provides its own interface. The ISE also provides a top-level, or executive interface, which supports the following major functions: 1) user logon and logoff, 2) navigation among the ISE's tools, 3) specification of user preferences, and 4) tool-level access control. The executive interface is customized based upon the access privileges and expressed preferences of each user.

5.1.1.2. Document Navigation and Browsing

To support IV&V personnel in accessing and browsing externally managed documents, as well as in providing others with access to IV&V documents, the ISE provides a hypertext-based

5. ARCHITECTURAL DESIGN

This section describes the architectural design of the ISE in terms of the functional and physical architecture. The functional architecture describes the functional capabilities that are made accessible to the ISE users based upon user classification and logon. The physical architecture defines the architecture from three perspectives which coincide to the network/computational infrastructure, the software infrastructure, and a high level view of the data to be maintained.

The architecture detailed is in compliance with the functional and performance requirements levied against the ISE by the ISE System Requirements document. The major functions of the ISE are described first, and are then selectively mapped into physical (software and hardware) elements.

5.1. Functional Architecture

The overall function of the ISE is to provide analysts and management personnel with access to the tools and information needed to effectively perform the EOSDIS IV&V contract. The general types of information to be managed include requirements, interface specifications, design data, test plans and procedures, test results, discrepancy reports, schedules, and a wide variety of project documentation. The major component associated with this information and data has been identified as the IIR. The ISE also provides access to a variety of tools that are used to access and manipulate this information, such as requirements and traceability analysis tools, system modeling and simulation tools, document browsing and management tools, and a variety of information management applications. This collection of tools is called the ISE Toolbox.

The functional architecture, as depicted in Exhibit 5.1-1, reflects various layers of software necessary to establish the ISE. Basically, the functional architecture is comprised of user interface capabilities with the ISE, functional capabilities necessary to support IV&V activities, data storage capabilities, and the necessary operating system and networking support.

4.2.4. Deliverables

EOSDIS Developers release document deliverables which provide the information base for performing IV&V analysis. Acceptable formats include both hard copy and electronic copy. Many of the deliverables have been made accessible via a Mosaic interface to the Hughes Electronic Data Handling System (EDHS). When this is not the case, electronic copies can also be imported into the ISE in either postscript or Microsoft Word format.

4.3. Internet

The Internet can also be viewed as an external interface to the ISE. Internet mail is output from the ISE and hypertext links to outside information sources are established via the ISE Mosaic Graphical User Interface (GUI).

For additional details regarding the various types of users and their interactions with the ISE, refer to the ISE System Requirements document.

4.2. EOSDIS Developers

The EOSDIS Developers are one of the ISE Users and they are responsible for designing and implementing the various EOSDIS components. In addition to being an ISE User to access data relevant to development, they also supply data and products which are ingested by the ISE. The following subsections define data imported from the EOSDIS Developers by the ISE.

4.2.1. Requirements Databases

As required by the IV&V task orders including requirement analysis activities (e.g. Task 5), IV&V analysis includes the assessment of requirements in terms of traceability. To perform this activity, the Requirements Traceability Management (RTM) tool is utilized. The RTM tool hosts its data in an Oracle database and provides import, export, and partitioning capabilities. The Hughes EOSDIS requirements database is ported to the RTM tool within the ISE to provide the information base for requirement traceability assessment. For specific details regarding the interface, refer to the RTM product documentation set.

4.2.2. Simulation Model Databases

IV&V activities include reviewing EOSDIS system simulation models for correctness. Various Hughes simulation models will be imported into the ISE hosted Block Oriented Network Simulator (BONeS) tool. For specific details regarding the data port, refer to the BONeS product documentation set.

4.2.3. Software Configurations

In order to execute the EOSDIS system for test validation activities, EOSDIS developer releases must be imported into the ISE for configuration control. At a minimum, these releases will include the executable modules and may include actual software configurations necessary for software builds given the need for special test drivers or testing configurations. In the instance where software configurations are to be imported, the interface to the ISE would take the form of a Configuration Management (CM) release from the ClearCase DM tool from Atria. For specific details regarding the data port, refer to the ClearCase product documentation set.

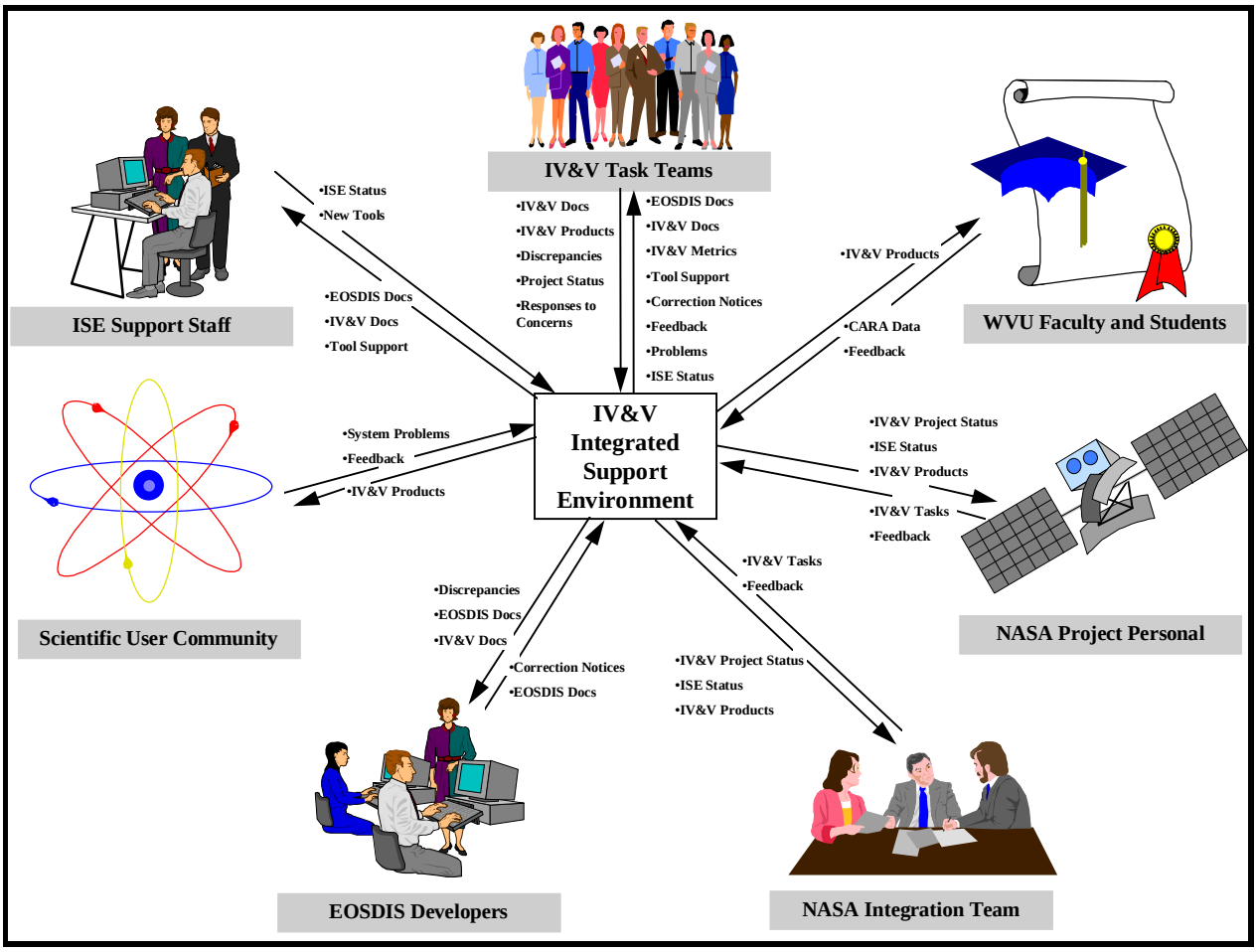

Exhibit 4.1-1 ISE User Community

The ISE Users interface to the ISE primarily consists of interfacing with COTS products and entering data to interact with the COTS products. One exception would be interfaces with tools developed by the ISE Support Staff. Currently, plans for new tool development address the following areas:

1. Document/Deliverable Browsing

   The interface to this tool will be a Mosaic GUI which has not yet been defined in its entirety.

2. Executive Interface

   A customized interface will be built for the PC and Sun platforms providing access to specific IV&V tools based upon user logon. These user interfaces are to be determined (TBD).

3. Client/Server Applications

   Various client/server applications are being targeted to aide analysis activities and to manage analysis data. Two prototypes defining the user interfaces are currently under development. These prototypes are candidates for porting to client/server applications. As the software development phases are undertaken, these interfaces will be defined.

4. EXTERNAL INTERFACES DESIGN

This section identifies the major interfaces and provides a point of reference for refinement as the software development life-cycle is initiated. The external interfaces to the ISE are the ISE users, import data from EOSDIS developers, and the Internet. Exhibit 4-1 below details the external interfaces at a high level via the ISE Context Diagram.

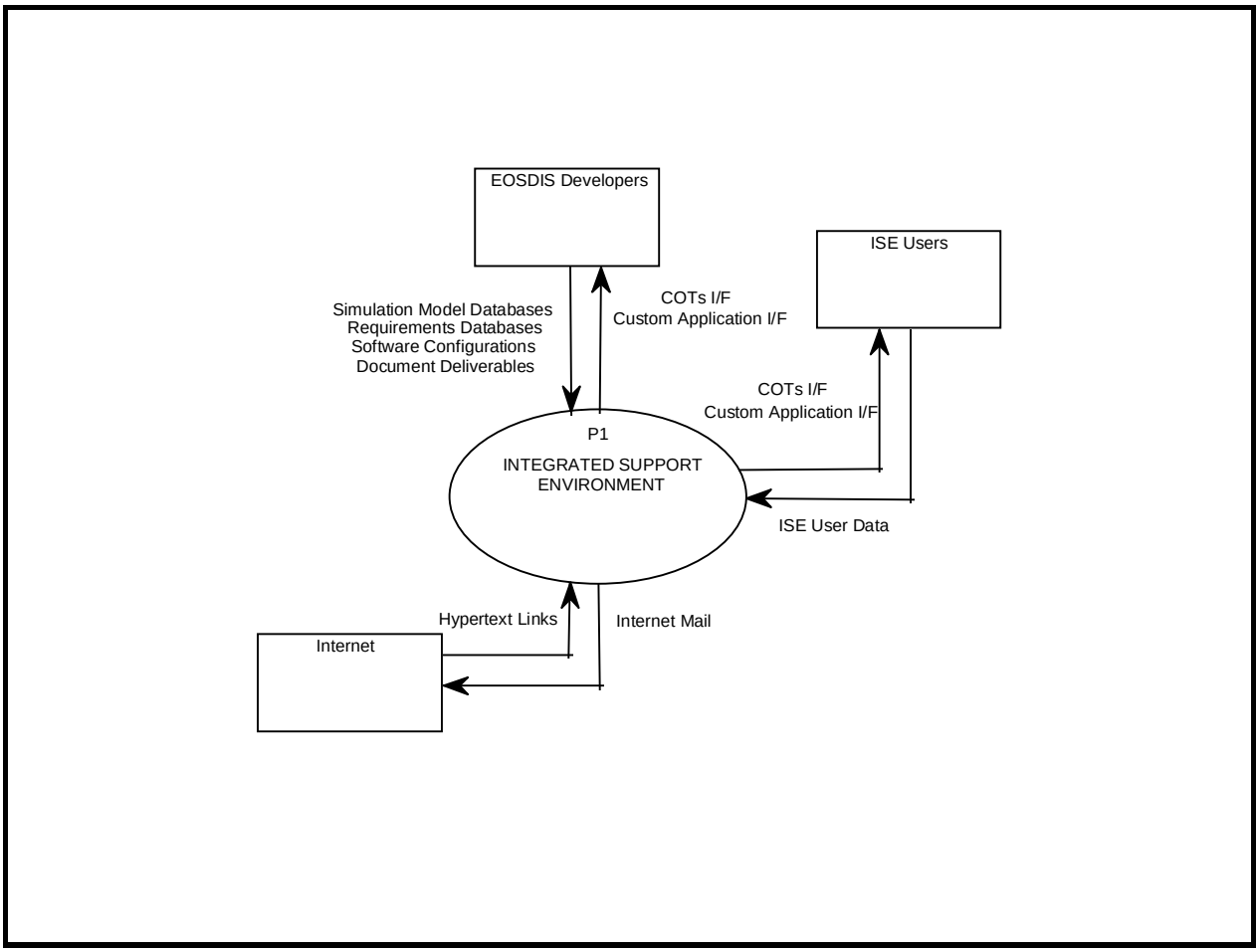

Exhibit 4-1 ISE Context Diagram

4.1. ISE Users

The ISE users hold a variety of positions, from system developer to NASA executive, each with their own unique set of needs. Exhibit 4.1-1 provides the categorization of the user community and characterizes their interaction with the ISE.

significant benefits can be garnered from selecting tools compatible with that of EOSDIS developers, tool selection may be delayed for certain classes of tools (e.g. testing tools) until after they have been incorporated into the developers environment.

Another aspect associated with the configuration and integration of COTS products is that of configurability. In some instances, the integration of COTS tools are more or less “plug and play”. However, in some instances (i.e. Microsoft Access, RTM, etc.) the use of a COTS tool may involve a substantial effort to configure the tool for use. Even though true development is not undertaken, a portion of the work parallels that of development in many ways. In establishing the ISE, the documentation necessary to maintain the configuration of COTS products is also to be maintained.

3.4. Spiral Model Selection

During the establishment of the ISE, IV&V task needs, in terms of tools and infrastructure, is continuously monitored. This in conjunction with the activation of additional IV&V tasks under the task order contract results in the need to provide incremental releases of the ISE. The phasing of these releases will be dependent upon the need dates for specific capabilities. When new development is required, a spiral model will be followed due to the inherent mechanisms for defining the end product.

The spiral model includes the conventional “waterfall” development steps, but it precedes these steps with a succession of cycles in which the system’s or software’s objectives are elaborated, alternatives are defined, risks and constraints are identified, and a prototype is constructed. The prototype is then evaluated and the next cycle is planned taking into consideration the revised objectives, alternatives, constraints and risks. This process of refinement and prototyping is repeated as many times as necessary, given schedule constraints, to provide a firm foundation for the detailed design, coding and test of the final software product. This cyclic prototyping approach provides the most effective forum for building tools that meet the IV&V task needs due to its inherent contextual communications with the ultimate end-users. Additionally, this prototyping approach provides an essential data capture capability so that a compatible database is constructed in conjunction with the software tool.

Because of the variety of information that exists in the IIR, not all users have access to all information. System level security is maintained and individual user access is on a need to know basis. Although the type of user matters, the location of the user does not. The IIR will be located at the WVU/NASA Software IV&V Center in Fairmont, West Virginia and accessible to the IV&V user community, regardless of their location, via the established communication architecture.

The user interface to the IIR is provided by front-end tools located in the ISE Toolbox. The Toolbox compartmentalizes all of the tools to meet the diverse needs of the ISE users and can be broadly characterized as follows:

- Information browsing tools
- Database application tools
- Analysis tools
- Tracking tools
- Testing tools
- Development tools
- Office automation tools

Front-end tools enable users to access the data and products stored in the IIR while providing a standard look and feel for navigating through the IIR. The Toolbox also contains office support tools, project management tools, test tools, performance and code analyzing tools, and interface analysis tools to support the daily needs of the IV&V task members. Where feasible, these tools are integrated to facilitate the sharing of data, enabling information to progress through the IV&V project life-cycle. Additionally, the Toolbox houses the tools necessary for the ISE support staff to establish and maintain the ISE. These tools are used to allow ISE support staff to develop new tools, manage, monitor and maintain computational resources, and perform configuration management of tools and data.

3.3. Configuration/Integration versus Development

The design approach selected for the establishment of the ISE primarily involves the configuration and integration of Commercial Off-The-Shelf (COTS) and public domain (freeware) software products. This approach stems from the requirement to support all IV&V task needs in a timely and effective manner and the limited resources available to undertake large tool development efforts. In light of this approach, any development initiatives will be focused towards applications that can not be satisfied by the available COTS products or where a custom application yields significant benefit gains in terms of data integration, ease of use, and analyst productivity. Two specific development areas, however, have been targeted. They are the development of standard interfaces to ISE tools and data and data integration through the implementation of various client/server related applications.

A priori specification of selected tools and technologies, driven by capability, cost, deployability, and compatibility factors, represents various integration aspects of the ISE. For example, when

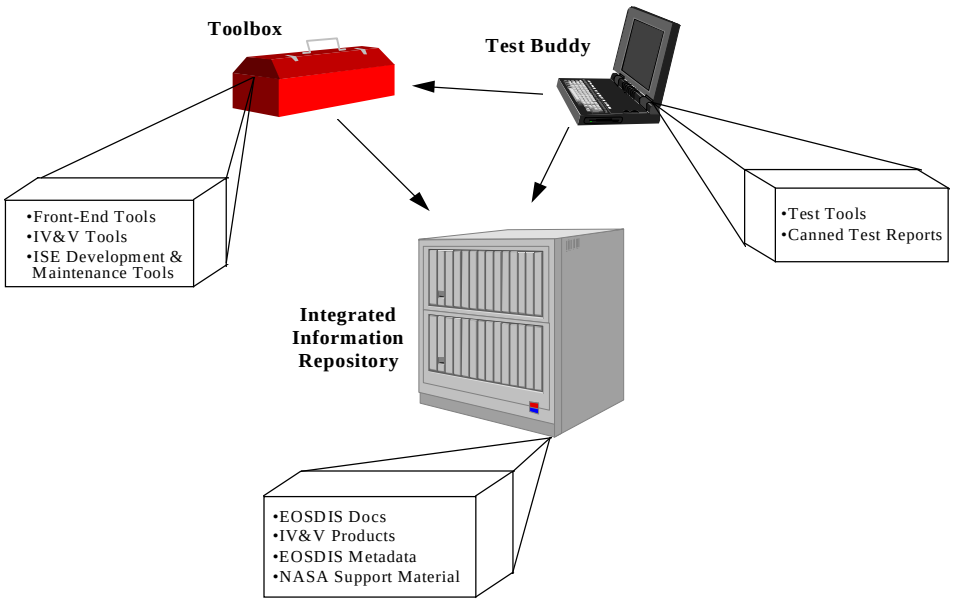

Exhibit 3.2-1 ISE Components

Exhibit 3.2-2 maps the identified objectives to the components of the ISE and indicates how the objectives are satisfied.

OBJECTIVE	COMPONENT	OBJECTIVE SATISFACTION
• Provide tool support for IV&V tasks	Toolbox	• The Toolbox houses IV&V tools to support daily needs
• Provide visibility to EOSDIS IV&V products, results, and data	Integrated Information Repository and Toolbox	• The IIR archives all EOSDIS IV&V products and data • The Toolbox provides front-end tools to access these products and data
• Provide visibility to EOSDIS development and integration documentation	Integrated Information Repository and Toolbox	• The IIR archives all EOSDIS products and data relevant to the IV&V effort • The Toolbox provides front-end tools to access these products and data
• Provide remote site access to IV&V test information	Test Buddy	• The Test Buddy is a standalone, portable platform providing access to ISE tools and data.

Exhibit 3.2-2 ISE Objective/Component Mapping

3. DESIGN APPROACH AND TRADEOFFS

3.1. Purpose and Objectives

The purpose of the EOSDIS IV&V Integrated Support Environment (ISE) is to ***provide consistent, accessible, and controlled use and availability of tools and information to the ISE user community independent of user location***. By maintaining the focus of this purpose, the ISE provides virtually all IV&V and other COTR-authorized personnel access to EOSDIS IV&V data, tools, and information to support their full range of activities. The primary objectives of the ISE are as follows:

- To provide tool support for IV&V tasks
- To provide visibility to EOSDIS IV&V products, results, and data
- To provide visibility to EOSDIS development and integration documentation
- To provide remote site access to IV&V test information

3.2. ISE Components

The ISE consists of the **Integrated Information Repository (IIR),** the **Toolbox,** and the **Test Buddy.** Together these components support the ISE user community by providing an integrated environment which automates and integrates various aspects of IV&V task processes, tools and data. Significant benefits are realized by the integration and can be attributed to one or more of the following:

- Information sharing
- Increased productivity
- Analysis repeatability
- Data integrity
- Completeness
- Consistency
- Product quality
- Product integrity

The IIR is the heart of the ISE, holding all the IV&V project data and results, as well as the EOSDIS development information. This repository is accessible to the user community via front-end tools provided by the Toolbox, the second component of the ISE. Along with the front-end tools, the Toolbox contains all of the IV&V tools necessary for the IV&V task team to perform their daily IV&V responsibilities. The output products and data generated or utilized by the tools are stored in the IIR. The third and final component, the Test Buddy, is a self-contained, portable platform with accessibility to the ISE. The Test Buddy enables IV&V testers to complete test scenarios and cases on site with the ability to access information in the IIR and to rapidly submit test results. Exhibit 3.2-1 illustrates these three components of the ISE and their relationships.

14. “EOSDIS IV&V Task 11 Key Interface Testing Statement of Work”, dated 11 October 1994.

15. “EOSDIS IV&V Task 12 EDOS IV&V Statement of Work”, dated 17 October 1994.

16. “EOSDIS IV&V Task 13 IV&V Special Studies Statement of Work”, dated 15 November 1994.

2.2. Applicable Documents

The following documents are referenced herein and are directly applicable to this volume:

1. "Earth Observing System (EOS) Performance Assurance Requirements (PAR) for the Independent Verification and Validation (IV&V) of the EOS Data and Information System (EOSDIS)", GSFC 420-05-05, dated March 23, 1993

2. "Statement of Work for the Independent Verification and Validation (IV&V) of the EOS Data and Information System and Key EOS Ground System Interfaces", dated April 19, 1993

3. "NASA Software Documentation Standard Software Engineering Program (NASA-STD-2100-91)”, dated July 29, 1991

4. “Software Management and Assurance Program (SMAP) Information System Life-Cycle and Documentation Standards Information System Design Data Item Description (SMAP-DID-P300-SY), dated February 28, 1989

2. RELATED DOCUMENTATION

2.1. Parent Documents

The following documents are parents to this document:

1. "Integrated Support Environment (ISE) System Requirements", dated 28 October 1994.

2. "Independent Verification and Validation Management Plan (IVVMP)", dated 15 August 1994.

3. "Independent System Verification & Validation Plan (ISVVP)", dated 17 October 1994.

4. "EOSDIS IV&V Task 1 IV&V Project Management Statement of Work", dated 11 October 1994.

5. "EOSDIS IV&V Task 2 Facilities, Operations, and Program Reporting Statement of Work", dated 17 October 1994.

6. "EOSDIS IV&V Task 3 Independent Verification and Validation Plans Statement of Work", dated 11 October 1994.

7. "EOSDIS IV&V Task 4 IV&V Infrastructure and Tool Development Task Statement of Work", dated 11 October 1994.

8. "EOSDIS IV&V Task 5 Requirements Analysis and Traceability Task Statement of Work", dated 11 October 1994.

9. "EOSDIS IV&V Task 6 ECS Interim Release 1 Development Analysis Task Statement of Work", dated 11 October 1994.

10. "EOSDIS IV&V Task 7 ECS Release A Development Analysis Task Statement of Work", dated 11 October 1994.

11. "EOSDIS IV&V Task 8 ECS Release A IV&V Test and Test Scenario Generation Statement of Work", dated 11 October 1994.

12. "EOSDIS IV&V Task 9 Key Interface Analysis Statement of Work", dated 11 October 1994.

13. "EOSDIS IV&V Task 10 Development of EOS Ground System Certification Plan Statement of Work", dated 11 October 1994.

Section 3 describes the ***design approach and tradeoffs*** addressed during the formulation of the ISE System Architecture. Items addressed include development model selection as well as some high level objectives.

Section 4 details the ***external interfaces design*** for external interfaces based upon levied requirements. This section identifies the major external interfaces and provides as much detail as is known at this time. Updates will be made as the design progresses.

Section 5 explains the ***architectural design*** in terms of both the functional and physical architecture. With regards to the physical architecture, products that have been procured, are being procured, or are leading candidates are included.

Section 6 contains the ***requirements allocation and traceability*** information which traces the system level requirements detailed in the ISE System Requirements document to elements of the architectural design.

Section 7 delineates the ***partitioning for incremental development***. In adhering to a spiral model for development, various incremental deliveries are anticipated. These incremental releases of the ISE are TBD.

Section 8 contains the ***abbreviations and acronyms*** for the document.

Section 9 contains the ***glossary*** for the document.

Section 10 contains any ***notes*** generated regarding the document.

Section 11 contains ***appendices*** associated with the document.

capabilities that are made accessible to the ISE users based upon user classification and logon. The physical architecture defines the architecture from three perspectives which are the various data views, the software infrastructure, and the hardware/network infrastructure.

1.4. Document Status and Schedule

The dissemination of this DRAFT release of the ISE System Architecture document provides an initial baseline to obtain feedback from the IV&V task leads and the Contracting Officer Technical Representative (COTR). The feedback obtained will be considered for incorporation into the first official release of the document which is scheduled for 31 January 1995. This document, along with inputs received, will provide a material base for the ISE System Architecture Review scheduled for 16 January 1995. Subsequent revisions of this document and the parent ISE System Requirements document (deliverable 0404) will be released as new task order requirements are levied against the ISE.

Deliverable milestones/requirements:

- ISE System Architecture Document -- DRAFT 16 December 1994
- ISE System Architecture Review 16 January 1995
- ISE System Architecture Document -- Revision 0 31 January 1995
- ISE System Architecture Document -- Revision “n” As required

The initial release of the ISE will be fielded in February 1996 and will evolve as additional IV&V needs are defined during the span of the EOSDIS project.

1.5. Documentation Organization

The organization of this document conforms to a Data Item Description (DID) from the NASA Information System Life-Cycle Documentation Standard. Specifically, the format and content of this document parallels that of the Information System Design DID (SMAP-DID-P300-SY). This DID is used because the NASA Software Documentation Standard (NASA-STD-2100) does not include a “system level design” DID. The NASA-STD-2100 only contains “software level” DIDs. The utilization of the SMAP-DID-P300-SY was approved by NASA following the review of submitted justification data.

The following sections are dictated by the SMAP-DID-P300-SY DID:

Section 1 establishes the context of the document through an ***introduction***. This section identifies the document, the scope, purpose, objectives and the status of the document.

Section 2 lists the ***related documentation*** including parent documents and applicable documents.

1.2. Scope of Document

This document defines the system architecture for the ISE being developed under the EOSDIS IV&V Infrastructure and Tools Task. It characterizes the network, hardware, and software infrastructure necessary to support IV&V activities based upon the current IV&V task orders and reflects the needs and capabilities required to support the following active EOSDIS IV&V tasks:

- Task 1 -- IV&V Project Management
- Task 2 -- Facilities, Operations, and Program Reporting
- Task 3 -- Independent Verification and Validation Plans
- Task 4 -- IV&V Infrastructure and Tool Development Task
- Task 5 -- Requirements Analysis and Traceability Task
- Task 9 -- Key Interface Analysis
- Task 10 -- Development of EOS Ground System Certification Plan

Additionally, the ISE system architecture has been detailed based upon the Independent System Verification and Validation Plan (ISVVP) and information garnered from the other EOSDIS IV&V task orders which have been issued. New ISE requirements and architecture related needs are anticipated as work progresses for the following IV&V task orders:

- Task 6 -- ECS Interim Release 1 Development Analysis Task
- Task 7 -- ECS Release A Development Analysis Task
- Task 8 -- ECS Release A IV&V Test and Test Scenario Generation
- Task 11 -- Key Interface Testing
- Task 12 -- EDOS IV&V
- Task 13 -- IV&V Special Studies

This architecture document includes varying levels of detail due to the nature of the task order contract and the state of EOSDIS development. For tasks that are active, some specific support tool solutions have been identified and have either been procured or are in the process of being procured. In other instances, a leading tool candidate or a class of tool has been identified, but not sufficiently evaluated to ensure it satisfies an IV&V task need. These instances occur when an IV&V task has yet to be initiated or when significant benefits can be realized by selecting tools which are compatible with the EOSDIS development community.

1.3. Purpose and Objectives of Document

This document communicates the current state of the ISE system architecture to the IV&V task team and to other external users of the ISE. The ISE System Architecture document is the primary product of the System Architecture Definition phase and is defined in terms of both the functional and the physical architectures. The functional architecture describes the functional

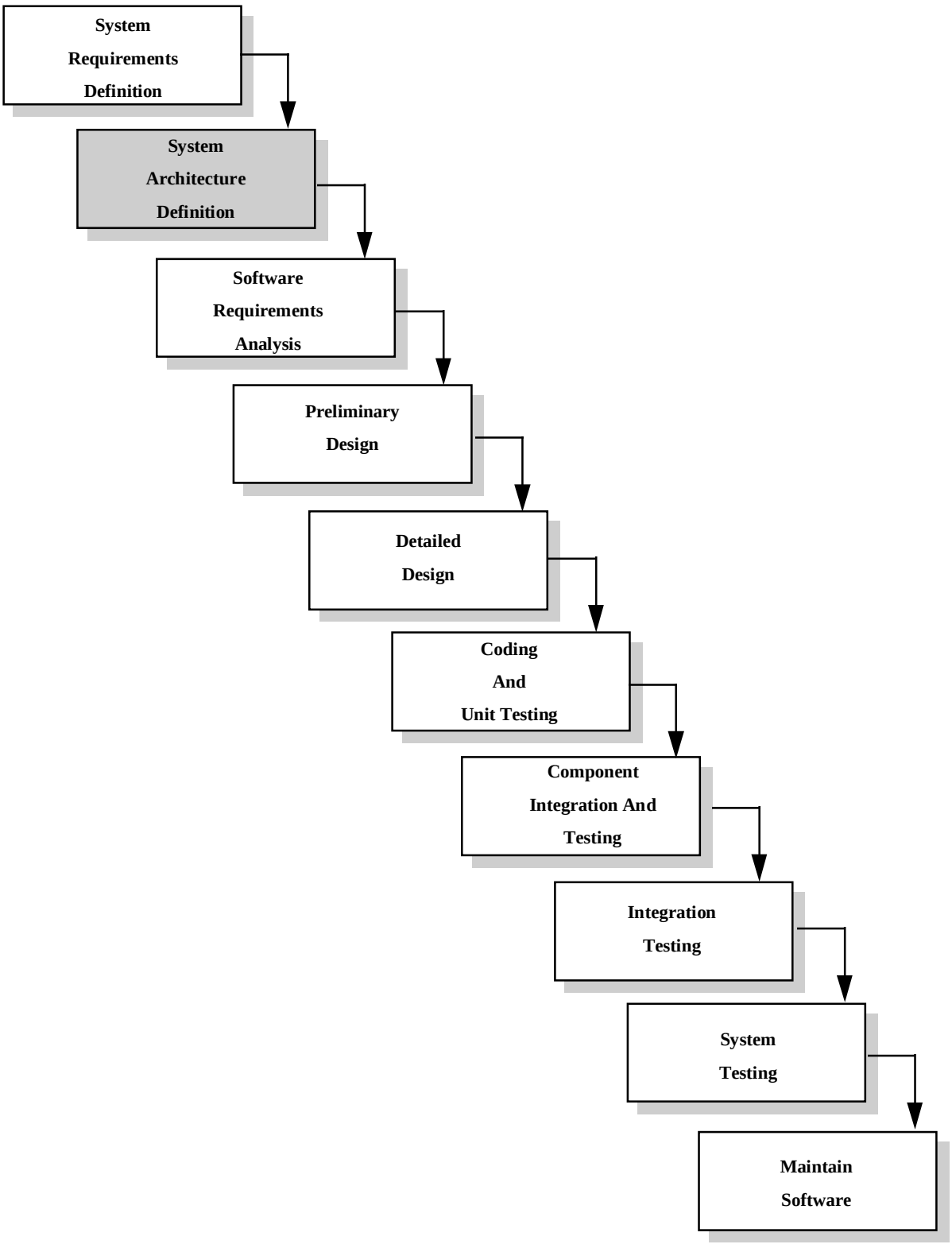

Exhibit 1.1-1 Software Development Process

1. INTRODUCTION

1.1. Identification of Document

This is the Integrated Support Environment (ISE) System Architecture document generated under the Independent Verification and Validation (IV&V) Infrastructure and Tools task order of the Earth Observing System Data and Information System (EOSDIS) IV&V contract. EOSDIS is being developed for the National Aeronautics and Space Administration (NASA) where Intermetrics is the IV&V prime contractor.

The ISE System Requirements Document, dated 28 October 1994, is the predecessor or parent of this system level architecture document. This ISE System Architecture document provides the framework and foundation for the ISE development activities which follow and supports the Software Development Lifecycle as depicted in Exhibit 1.1-1. The current EOSDIS software life cycle phase is highlighted.

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INTEGRATED SUPPORT ENVIRONMENT (ISE) SYSTEM ARCHITECTURE

(Deliverable 0405)

December 15, 1994

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(Deliverable 0405)

December 15, 1994

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